MRP Properties Company, LLC

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Brenda B. Epperson
Manager, Environmental

January 25, 2013

U.S. Environmental Protection Agency, Region 7
Air and Waste Management Division
RCRA Corrective Action & Permits Branch
ATTN: Brad Roberts
11201 Renner Boulevard
Lenexa, Kansas 66219

Chief of the Hazardous Waste Permits Section
Kansas Department of Health and Environment
Bureau of Waste Management
ATTN: Mostafa Kamal, P.E., CHMM
1000 SW Jackson, Suite 320
Topeka, Kansas 66612-1366

Re: Transmittal of Human Health Risk Assessment Work Plan
MRP Properties Company, LLC – Arkansas City, Kansas
EPA ID No. KSD 087418695
VIA FEDERAL EXPRESS TRK#'s: 7946 0565 8584 / 7946 0587 1359

Dear Mr. Roberts and Mr. Kamal:

The U.S. Environmental Protection Agency (USEPA) Region 7 issued MRP Properties Company, LLC (MRP) a Final Hazardous and Solid Waste Amendments (HSWA) Part II Permit (Part II Permit) on September 28, 2012. One of the requirements of the Part II Permit is to prepare a human health risk assessment (HHRA) work plan. The objective of the HHRA is to evaluate potential soil exposure pathways and receptors based on current and intended future commercial/industrial land use, as well as hypothetical future development of the site involving construction workers and/or utility workers.

MRP has completed the work plan as described in the Part II Permit. The HHRA work plan is enclosed for your review and approval. The HHRA work plan includes a review of the existing soil database and identifies data gaps in the soil database. A separate work plan to fill data gaps identified in the soil database will be submitted under separate cover by February 11, 2013.

A preliminary schedule to conduct the soil data gap investigation and HHRA is included in Section 6 of the interim measure operation and maintenance (IMOM) plan to be submitted under separate cover.

Two copies of the HHRA work plan are enclosed for the USEPA and one copy is enclosed for the KDHE. Additionally, one CD containing the HHRA in Adobe PDF format is enclosed for each agency.

If you have any questions or comments, please contact me at 210/345-4619 or Jay Mednick at 303/291-2262.

Sincerely,

BB Epperson

Brenda B. Epperson

Enclosure (1).

Cc: Kent Biggerstaff – MRP Properties Company, LLC (w/encl)
Jay Mednick – MWH (w/encl)

Human Health Risk Assessment Work Plan for Soils

Former Total Petroleum Refinery
Arkansas City, Kansas

PREPARED FOR:

MRP Properties Company, LLC.
1400 South M Street
Arkansas City, Kansas 67005

PREPARED BY:

BELLEVUE, WASHINGTON

AND

DENVER, COLORADO

DATE:

JANUARY 25, 2013

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
µg/m^3	micrograms per cubic meter
ABS_{GI}	oral absorption efficiency
AMSL	above mean sea level
AST	aboveground storage tank
bgs	below ground surface
CA	Canadian Fine Silty Loam
CDL	Construction Debris Landfill
CMS	Corrective Measures Study
cm^2	square centimeters
COPC	constituent of potential concern
CSF	cancer slope factor
CSM	conceptual site model
DA	Dale Silt Loam
EPC	exposure point concentration
EUs	Exposure Units
FCC	fluid catalytic cracker
EUSSI	Exposure Unit Supplemental Soil Investigation
HEAST	Health Effects Assessment Summary Tables
HFA	hydrofluoric acid
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
ILCR	incremental lifetime cancer risk
IRIS	Integrated Risk Information System
J&E Model	Johnson and Ettinger Vapor Intrusion Model
JSA	Junk Storage Area
kg	kilograms
kg/mg	kilograms per milligram
KDHE	Kansas Department of Health & Environment
LG	Lincoln-Tivoli Complex
LUCs	land use controls
m^3/kg	cubic meters per kilogram
mg/kg	milligrams per kilogram
mg/kg-day	milligrams per kilogram per day
mg/cm^2-day	milligrams per square centimeters per day
mg/m^3	milligrams per cubic meter
mg/µg	milligrams per microgram
MRP	MRP Properties Company LLC
MDL	method detection limit
MRL	method reporting limit
MWH	MWH Americas, Inc.
NPDES	National Pollutant Discharge Elimination System
PA	Process Area

PAH	polycyclic aromatic hydrocarbon
PPRTV	Provisional Peer Reviewed Toxicity Values
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RfC	reference concentration
RfD	reference dose
RFI	RCRA facility investigation
RSL	Regional Screening Level
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TPI	Total Petroleum, Inc.
UCL	upper confidence limit
URF	unit risk factor
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
VD	Verdigris Silt Loam
VOC	volatile organic compound
VSI	visual site inspection
Work Plan	HHRA Work Plan

1.0 INTRODUCTION

This human health risk assessment (HHRA) work plan (HHRA Work Plan) was prepared by MWH Americas, Inc. (MWH) on behalf of MRP Properties Company, LLC (MRP) for 13 exposure units (EUs) at the former Total Petroleum Refinery in Arkansas City, Kansas (the Site). In support of Resource Conservation and Recovery Act (RCRA) Corrective Measures Study (CMS) activities for the Site, MRP submitted an Exposure Unit Supplemental Soil Investigation Report ((EUSSI Report; MWH, 2011) to the Kansas Department of Health & Environment (KDHE) and the U.S. Environmental Protection Agency Region 7 (USEPA) in April 2011. The KDHE and USEPA provided written comments, dated 15 March 2012, on the EUSSI Report. Among other comments, the agencies requested that MRP conduct a baseline HHRA for the Site, and they suggested that several data gaps exist in the available site characterization data.

This HHRA Work Plan presents the methods and assumptions to be used in the preparation of a baseline HHRA for the Site. In addition, this HHRA Work Plan includes an evaluation of the adequacy of the 1999 and 2010 soil characterization data for use in risk assessment, and identifies several limitations and data gaps in the currently available data. Future plans for additional characterization of soils at the Site will be detailed in a separate Data Gap Characterization Work Plan to be submitted to KDHE and the USEPA. Human health risk and hazard estimates associated with impacted soil at the Site will be calculated following approval and implementation of the Data Gap Characterization Work Plan.

1.1 BACKGROUND

1.1.1 Site Location and History

MRP is the current owner of the Site which is located at 1400 South M Street in Arkansas City, Kansas. The Site is located in Cowley County just outside the Arkansas City, city limits. The former Total Petroleum Inc. (TPI) refinery was initially constructed in the 1920's and has had several different owners.

The Site occupies approximately 267 acres located within parts of Section 31 and 32 of Township 34 South and Range 4 East; and Section 5 of Township 35 South and Range 4 East, in Cowley County, Kansas. The Site is located near the confluence of the Walnut River and the Arkansas River, as shown on Figure 1-1. The eastern boundary of the refinery is approximately ½ mile upstream of the confluence of the two rivers. The Army Corps of Engineers constructed a levee system along the Arkansas and Walnut rivers to protect Arkansas City and the Site from floods.

The former refinery was operational from the 1920s until 1996. The facility is currently regulated under a RCRA post closure care permit with KDHE as the lead agency. A RCRA Facility Investigation (RFI) report (completed August, 1992), a Phase II RFI Report (completed June, 2000), a Corrective Measures Study (CMS) work plan (completed February, 2002), and a corrective action objectives document (completed May, 2005) have been

approved by the USEPA (May, 2005). In addition, an EUSSI Report was prepared for the Site and submitted to the agencies in April 2011. The EUSSI report was the subject of written comments from KDHE and the USEPA, dated March 15, 2012, and a meeting between MRP and the agencies on May 8, 2012.

Since initial operation in the 1920's, the Site has had several different owners. The Site was purchased by Total in April 1978 and this entity was the last owner to operate the former refinery, shutting down refining operations in 1996.

Refining operations (alkylation, crude, hydrocracker, reformer, etc.) at the facility were discontinued September 1996. The process units in the main process area and a majority of the tanks associated with the refinery were demolished by 2003. Asphalt operations were an integral part of the refinery operations and considered an operating unit as were the other operating units within the main process area. Asphalt operations occurred within the geographic area identified in the Phase II RFI Work Plan (Earth Tech, 1999), Phase II RFI Report (Earth Tech, 2000), and a Corrective Measures Study (CMS) Work Plan (RBA, 2002) as the "Process Area." Figure 1-2 contains a site plan delineating major areas at the Site.

Current operations consist of a terminal operation where asphalt is transported by truck to the terminal, stored, and then transported by truck to customers. The terminal does not process, mix, or blend asphalt at the Site. The only significant change from the current asphalt operations and the asphalt operations during the life of the active refinery is that asphalt is currently trucked into the facility instead of being a product of the operating refinery.

As a result of this long history of refining activity, petroleum is present in the subsurface at the Site. Hydrocarbon recovery from both the saturated and unsaturated zone has been ongoing at the Site since the early 1940's. A formal groundwater restoration program (hydrocarbon recovery) was initiated in 1982. The hydrocarbon recovery program has resulted in the installation of more than 100 groundwater monitoring wells and several groundwater and product recovery wells throughout the Site.

1.1.2 Previous RCRA Investigations

An RFI was conducted in 1990 and the final RFI report was completed by Roberts/Schornick and Associates in August, 1992. This investigation addressed soil, groundwater, surface water, and sediment. Additional delineation was conducted as part of a Phase II RFI investigation in 1999.

More recently the facility has been subject to decommissioning. The decommissioning has eliminated most of the structures on the property including underground piping to six feet below ground surface (bgs), and also resulted in the movement of some of the Process Area soil that was sampled in 1999. Consequently, not all of the Phase II RFI Process Area soil data are representative of current site conditions. In addition, some of the previous samples had results that were non-detect for site constituents but with elevated detection limits. Risk estimates in these areas have greater levels of uncertainty. As a result, additional soil data

were required to assess risk and determine which areas of the Site may require corrective action.

A work plan was submitted to the KDHE and the USEPA in July 2009 (MWH, 2009) to collect soil data to characterize the Site in support of risk-based decisions regarding the need for corrective action. Following comments from these agencies, a revised work plan (MWH, 2010a) was submitted and approved in October 2010. The field activities were begun that same month, and were conducted under the approved Field Sampling Plan (MWH, 2010b), and the approved Quality Assurance Project Plan (MWH, 2010).

The methods used in, and results of, the supplemental soils investigation (SSI) were documented in the *Soil Exposure Unit Supplemental Soil Investigation Report* (EUSSI Report; MWH, 2011). The KDHE and USEPA-Region 7 provided comments on the EUSSI Report, dated 15 March 2012, and MRP submitted responses to comments, dated 11 April 2012. The KDHE and USEPA-Region 7 provided follow-up comments on the EUSSI Report, dated 24 May 2012. Among other comments, the KDHE and USEPA-Region 7 requested that a baseline HHRA be prepared for the Site. This HHRA Work Plan was prepared in response to the agencies' request for a baseline HHRA.

1.1.3 Investigation Framework

A framework for evaluation of the soil impacts at the Site has previously been developed, including the establishment of soil cleanup goals (RBA, 2005). These goals were approved by the USEPA (USEPA, 2005).

The soil cleanup goals were risk-based values, assuming that future use of the Site being non-residential. A likely future land use may involve subdivision for industrial and commercial use. The soil cleanup criteria were based on exposure of a site worker to soil.

The areas investigated as part of the SSI were the Process Area (PA), the Junk Storage Area (JSA), and the Construction Debris Landfill (CDL) Area (Figure 1-2). The Main Process Area, a subunit of the Phase II RFI Process Area, is where the petroleum refining operations occurred. Several Solid Waste Management Units (SWMUs) were identified in this area. The Junk Storage Area is where equipment was staged prior to being scrapped or reused. The CDL Area contains three SWMUs: SWMU-14, SWMU-16, and SWMU-47. The CDL area was not investigated in the Phase II RFI. In addition to the soil borings described in the work plan and the field sampling plan; MRP installed 18 supplemental (additional) soil borings (SSBs). Three of the SSBs are associated with two EUs.

The SSI broke up these areas into 13 Exposure Units (EUs) (MWH, 2010a). These included the Process Area (11 EUs), Junk Storage Area, and the CDL Area. The EUs are areas within which risks are calculated.

The EUs, with the exception of the CDL area, are a maximum of five acres, based on the likelihood that parcels sold to individual developers would be at least this size. It is recognized that a worker will only be exposed to a small area within any EU, as individual parcels will largely be paved or covered with structures, and worker exposure will be confined to the remaining area. These unpaved areas will not be regular work areas in most instances. However, during development, soil will be moved about a parcel and mixed. The best basis for estimating future worker exposure is average constituent concentrations in soil from the entire EU. The CDL is approximately 14 acres and its location outside the Walnut River and Arkansas River levee prevents the likelihood of future development.

In preparing the Work Plan for the SSI, it was determined that the USEPA preliminary remediation goals (PRGs) had been replaced with USEPA Regional Screening Levels (RSLs) (USEPA, 2010a). Furthermore, the SSI soil samples for not only the previously identified constituents of potential concern (COPCs), but a suite of volatile organic compounds (VOCs) (benzene was the only VOC that had been previously identified as a COPC) were evaluated in this investigation. As a result, a framework based on USEPA's Regional Screening Levels for Soil (USEPA, 2010a) was used to re-evaluate whether any VOCs besides benzene should be identified as a COPC. In addition, since the CDL was not sampled during the Phase II RFI, the lead data from the CDL would also be evaluated for potential inclusion as a COPC.

1.2 PURPOSE AND SCOPE

Current RFI and CMS activities are addressing three portions of the Site: the PA, which consists of 11 individual EUs of five acres each, the JSA, and the CDL. At the request of KDHE and the USEPA, MRP has agreed to conduct a baseline HHRA for these three areas. The purpose of this HHRA Work Plan is to describe the methods and assumptions that will be used during the preparation of a baseline HHRA for these areas. In addition, this HHRA Work Plan includes an evaluation of the adequacy of the 1999 and 2010 soil characterization data for use in risk assessment, and identifies several limitations and data gaps in the currently available data. Future plans for additional characterization of soils at these areas will be detailed in a separate Data Gap Characterization Work Plan to be submitted to KDHE and the USEPA. Human health risk and hazard estimates associated with impacted soil at these areas will be calculated following approval and implementation of the Data Gap Characterization Work Plan. The remaining portions of the Site, including the former Tank Farm, will be evaluated at a later time.

The baseline HHRA to be prepared for the PA, JSA and CDL will evaluate potential cancer risks and non-cancer hazards for human receptor exposed to contaminants in soil to a depth of 10 feet (ft) below ground surface (bgs). This soil depth accounts for potential exposures that may result from future construction activities at the Site. Contaminated groundwater at the Site is captured, treated and discharged to the Walnut River in accordance with a NPDES permit. In addition, there are no potable wells on-Site and the installation of potable wells will be prohibited in the future. Therefore, potential risks associated with hypothetical future potable uses of groundwater beneath the Site will not be evaluated in the baseline HHRA. The Site is proposed for future commercial/industrial development, and there is a potential for

vapor intrusion of volatile organic compounds (VOCs) in groundwater to above-ground indoor air in the future. However, the current groundwater treatment system is decreasing VOC concentrations in groundwater; therefore this potential, future exposure pathway will be addressed at a later time, as necessary. The Site currently contains no significant habitat for wildlife, and enhancement for wildlife use is not planned. Plans for future uses of the Site are limited to commercial/industrial development. Consequently, an ecological risk assessment will not be performed for the Site.

1.3 ORGANIZATION

This Work Plan consists of five sections, as described below.

Section 1.0 – Introduction: Describes the Site background, the purpose and scope of this HHRA Work Plan, and the organization of this Work Plan.

Section 2.0 – Project Setting: Presents detailed descriptions and operational histories for the EUs, and summarizes the environmental setting.

Section 3.0 – Data Summary and Evaluation: Presents the data usability requirements for environmental data that will be used in the HHRA, summarizes the existing soil investigation data for the Site, and describes limitations and data gaps in the current soil investigation data.

Section 4.0 – Human Health Risk Assessment Methods: Describes the methods and assumptions to be used in the preparation of a baseline HHRA for the Site.

Section 5.0 – References: Lists the reference documents cited in this Work Plan.

2.0 PROJECT SETTING

General descriptions of the environmental and human settings for the Site are presented in this section.

2.1 FACILITY DESCRIPTION

The Site is located southeast of the incorporated limits of Arkansas City in southwestern Cowley County, Kansas. It occupies approximately 260 acres northwest of the confluence of the Walnut and Arkansas Rivers. Petroleum refining facilities occupied the northern portion of the Site, while the CDL, former Tank Farm, and JSA occupied the southern portion of the Site. Refining facilities and infrastructure have been removed, as described below.

2.1.1 Site Operations

The former Total Refinery, which was operational from the 1920s until September 1996, produced unleaded gasoline, liquefied petroleum gas (LPG), propylene, fuel oils, jet fuels, and asphalt at a nominal operating capacity of 60,000 barrels per day. The refinery received approximately 85% of its crude oil supply by pipeline and transported approximately 85% of its refined products by pipeline. The remaining product was transported by truck. The integrated refining processes included two crude fractionation units, a hydrofluoric acid (HFA) alkylation unit, two catalytic reformers, gas plant, hydrocracker, propylene splitter, sulfur recovery plant and other supporting facilities.

As a result of the long history of refining activity, petroleum is present in the subsurface in portions of the Site. Hydrocarbon recovery from both the saturated and unsaturated zone has been ongoing at the Facility since the early 1940s. In 1982, Total initiated a formal groundwater restoration program (hydrocarbon recovery) within the main part of the Site. The hydrocarbon recovery program has resulted in the installation of more than 100 groundwater monitoring wells and several product recovery wells throughout the Site. Most of the monitoring wells were installed for the purpose of delineating the areal extent and thickness of hydrocarbon in the groundwater beneath the Site. Currently the Site operates a groundwater containment system as a corrective action requirement of the facility's Hazardous Waste Management Permit and a hydrocarbon recovery system within the Site to recover free phase hydrocarbon product.

Decommissioning has eliminated most of the structures at the Site including buildings and underground piping to six feet below ground surface in the PA. Currently, a portion of the Site is used as an asphalt distribution terminal. The asphalt is received from off-Site sources via truck and then transported off-Site to customers via truck. Asphalt is not processed, blended, or mixed at the Site. Storm water from the asphalt operation area is captured in a lift station and is treated in the wastewater treatment system and discharged under the facility's National Pollution Discharge Elimination System (NPDES) permit.

The refinery process units and tank farm have been demolished and removed. Additional

descriptions of the three areas to be evaluated in the baseline HHRA are provided below.

2.1.2 Process Area

The refinery process units covered the portion of the closed refinery between the railcar loading/offloading area to the north and the tank farm to the south as shown on Figure 2-1.

The PA encompasses the former refinery process units and extends north across the railroad spur toward the Walnut River. The PA includes former process units, the asphalt unit, and components of the former waste water treatment system (MWH, 2012). The PA encompasses approximately 46 acres.

2.1.3 Junk Storage Area

The JSA, designated SWMU-20, is a flat, open area that covers approximately 5.5 acres. The area was used as a lay down yard for a variety of scrap materials.

There were no releases described in the files reviewed during Phase 1 RFI activities (PRC, 1997). During the visual site inspection (VSI) conducted in 1987, however, there appeared to be at least two areas that were of concern. Drums containing asphaltic or oily sludge were found in a degraded condition in the area. Other drums with solidified material were found near a trash mound. These drums were removed from the area. During Phase I of the RFI, surface soil samples collected from SWMU 20 were analyzed for oil and grease. These data are summarized in Table 16 of the Final Phase I RFI Report (RSA, 1992).

Additional sampling was conducted in 1999 during the Phase II RFI and the results are included in the Phase II RFI Report (Earth Tech, 2000). Subsequently, in 2010 additional soil samples were collected during the EUSSI (MWH, 2011). The results of the soil sampling were submitted to KDHE and EPA on April 21, 2011.

2.1.4 Construction Debris Landfill

The CDL, designated Solid Waste Management Unit (SWMU) 47, is a permitted construction demolition landfill that covers approximately 14 acres. The unit started in 1982. The CDL received permit number 523 through the solid waste division of KDHE for operating a solid waste disposal area. The area covered by the CDL includes Oily Lagoon No. 2 (SWMU-14), which covered approximately three acres, and a one acre fluid catalytic cracker (FCC) catalyst disposal area (SWMU-16).

Extensive soil sampling was conducted in the CDL area during the fall of 2010 during the EUSSI to characterize the soil impacts in the area occupied by SWMUs 14, 16, and 47. The CDL is approximately 14 acres and its location outside the Walnut River and Arkansas River levee prevents the likelihood of future development.

2.2 ENVIRONMENTAL SETTING

The Site is bordered to the southwest, north, and east by the Arkansas and Walnut rivers, respectively (Figure 2-1). The U.S. Army Corps of Engineers (USACE) constructed a levee system along the Arkansas and Walnut rivers to protect Arkansas City and the Site from floods. However, the CDL is outside the USACE constructed levee and while it is protected by a levee constructed by TPI, the CDL is shown to be within a 100-year Federal Emergency Management Agency (FEMA) flood plain. The majority of the land surrounding the Facility is cultivated for wheat and sorghum production. A large flour mill borders the Site to the north, the area to the northwest is residential, a recreational area and the Arkansas City sewage treatment plant lie directly west of the Site, and the Kaw Wildlife Area is located to the south and southeast. The direction of groundwater flow at the Site is to the northeast. Several active oil production wells are located in the immediate vicinity. Currently, there is minimal industrial activity at the Site which is limited to a small asphalt terminal. Future land use at the Site is expected to remain industrial or commercial. The Site currently contains no significant habitat for wildlife, and enhancement for wildlife use is not planned.

2.2.1 Site and Vicinity Land Use

The Site is currently zoned industrial, and land use at the Site is expected to remain industrial. Land directly to the west is zoned single family residential. The area to the southwest is zoned heavy industrial and is the location of the Arkansas City sewage treatment plant. Land use to the north is limited industrial, including a large flour mill on the north border. A gravel mining operation is present in industrial land to the south, and the Kaw wildlife management area is located adjacent to the south and southeast of the Site. The nearest residential property east of the Site is over a quarter of a mile away across the Walnut River.

The regional and local setting of the facility is summarized in the following sections. Regional hydrogeology was investigated as part of the RFI and submitted with the August 4, 1992 Final RFI Report (RSA, 1992).

2.2.2 Geology and Soils

The facility has very little relief and gently slopes towards the northeast. Facility elevations range from approximately 1,078 feet above mean sea level (AMSL), near the southern boundary of the facility, to 1,045 feet AMSL, at the east side of the facility.

The Site is located southeast of Arkansas City in Cowley County, Kansas. Cowley County is in south central Kansas. Structurally, this area is east of the Nemaha Ridge, and west of the Dexter Anticline. Locally, the facility is located at the confluence of the Arkansas and Walnut Rivers. The region is underlain by Permian-age rocks that dip toward the west (Bayne, 1962). Quaternary alluvium overlies these Permian deposits and is found along major rivers and streams.

The areas along both the Arkansas and Walnut Rivers, including the facility, are underlain by

unconsolidated Quaternary-age alluvial deposits. These deposits consist of clay, silt, sand, chert, and limestone gravel (RSA, 1992). The thickness of alluvial deposits in the region is typically less than 25 feet, although recent alluvial deposits along the Arkansas River can be as much as 50 feet in thickness.

The bedrock surface in the area is the Permian-age Chase Group that is comprised of interbedded limestone, chert, and shale. The Chase Group has a total thickness of about 350 feet; about half of which is limestone and the other half shale (Bayne, 1962). Bedrock dips to the west, with younger Permian rocks of the Sumner Group regionally overlying the Chase Group. The Chase Group overlies older Permian rocks of the Council Grove and Admire Groups. Progressively older lithologies are exposed at the surface east of the Site.

There are three prominent structures in Cowley County, the Dexter Anticline, the Winfield Anticline, and the Nemaha Anticline. The Dexter Anticline is located in the eastern part of the county and trends northeast southwest. The east flank has a dip of over 200 feet per mile, while the west flank has a dip of about 100 feet per mile. The Winfield Anticline, which trends northeast-southwest in the central part of the county has a dip less than the Dexter Anticline but can be observed in surface features. The Nehema Anticline extends from central Oklahoma to northeast Kansas, and crosses the northwestern corner of the county. None of these structural features significantly affects the geology at the Site.

According to the United States Department of Agriculture (USDA) Soil Survey of Cowley County (1980), there are four soil types found at the facility; the Canadian Fine Silty Loam (CA), the Dale Silt Loam (DA), the Lincoln-Tivoli Complex (LG) and the Verdigris Silt Loam (VD).

Canadian series (CA) soil is generally deep, well drained, with moderately rapid permeability. This soil type ranges in depth up to about 60 inches and is formed in loamy and sandy alluvium. Slopes of this soil type range from 0 to 1 percent. Canadian series soil is generally located in the southern portion of the facility.

Dale series (DA) soil type is generally deep, well drained and moderately permeable. Soil depths occur to about 60 inches, and are formed in loamy alluvium. This soil type has slopes of about 0 to 1 percent and trend in an east west direction in the central portion of the facility.

The Lincoln-Tivoli Complex (LG) soil type tends to be a deep soil that is excessively drained with rapid permeability. The depth of this soil type occurs within the upper 60 inches. This soil type is found on floodplain or terrace deposits. Slopes of this soil type range from 0 to 15 percent and are found along the Arkansas and Walnut Rivers at the northeastern and southern boundaries of the facility.

The Verdigris Series (VD) soil type is deep and moderately well drained and has moderate permeability. Soil depths occur to about 60 inches and form in silty alluvium. Slopes of this soil type are about 0 to 2 percent and are found on low terraces and floodplains. The Verdigris soil type is located on the northern side of the facility.

2.2.3 Hydrogeology

Groundwater occurs in alluvial and bedrock aquifers in the vicinity of the Site. The alluvial deposits along the Arkansas River Valley provide large quantities of water (500 to 1,000 gallons per minute) which ranges in quality from good to poor. Locally, groundwater from bedrock aquifers can yield large to small quantities of water that ranges from good to poor quality. Chloride concentrations in water wells completed in alluvial sediments at the Site vicinity range from approximately 16 ppm to 650 ppm (Bayne, 1962).

Recharge of alluvial aquifers in the region is due mainly to infiltration of precipitation. On an intermittent basis, the Arkansas and Walnut Rivers contribute to alluvial aquifer recharge (Bayne, 1962). During flood conditions, when river water elevations are above the level of the groundwater in the aquifer, movement is in the direction of the aquifer (away from the stream) and aquifer recharge occurs. Regionally, discharge of groundwater usually occurs by flow to streams and rivers, and by evapotranspiration, pumping, and leakage into hydraulically connected aquifers.

2.2.4 Surface Water

The Site is located between the Arkansas and Walnut Rivers upstream of the confluence of the two rivers. The Arkansas River flows southeasterly through Arkansas City then meanders to the northeast where it merges with the south-southeast flowing Walnut River. The two rivers are principal waterways in Cowley County.

Portions of the Site are located within the 100-year flood plain of the Walnut River and the Arkansas River. The maximum peak flow recorded on the Arkansas River is 103,000 cubic feet per second (cfs) on June 10, 1923 and on the Walnut River, the maximum peak flow recorded is 105,000 cfs on April 23, 1944. The maximum peak flow periods of record for the Arkansas and Walnut Rivers are 1903-2009 and 1898-2009, respectively.

Mean daily flows from the Arkansas City gauging station on the Arkansas River and the Walnut River for 1960 through 2010 were obtained from the USGS. For the Arkansas River at Arkansas City (USGS Station 07146500) the mean of the annual maximum mean daily flow was 29,161 cubic feet per second (cfs). The month when the annual maximum occurred was highly variable from year to year, generally occurring from March through June, or from September through November. The mean of the annual minimum mean daily flow at this station and for this period was 317 cfs. The month when the annual minimum occurred was generally either January or from August through October.

For the Walnut River at Winfield (USGS Station 07147800) the mean of the annual maximum mean daily flow for this period was 24,088 cfs. The month when the annual maximum occurred was again highly variable but most often from April through June, or in November. The mean of the annual minimum mean daily flow for the Walnut River at Winfield for this

period was 56 cfs. The month when the annual minimum occurred was most often August, September, or October.

2.2.5 Climate

According to USACE, December 1984, the climate of Cowley County, Kansas is normal for middle latitude, interior continental areas. It is characterized by large variations in annual and daily temperatures, long, hot summers and cold, short winters. The average daily temperature in winter is 36.6°F. The recorded high and low temperatures for Cowley County are 118°F on August 12, 1936 and -27°F on February 13, 1905, respectively.

Long-term precipitation data are currently available for the 1971-2000 30-year climate normals period. Precipitation in Cowley County is highest during the spring and summer (April-September). Seventy-two percent of the average annual precipitation of 36.7 inches occurs during late evening or nighttime thunderstorms. Ten to eleven inches of the annual precipitation occurs as snowfall.

Occasionally tornadoes and severe thunderstorms occur within Cowley County. Storms are usually localized in extent and are of short duration. Crop damage by hail is not as extensive in Cowley County as in areas further west.

The closest location recording data on wind speed and direction is Wichita, Kansas. The wind rose (MWH, 2011) for Wichita, Kansas (2000-2009) indicates that the prevailing wind is from the south at an annual mean speed of 13 mph. The secondary prevailing wind direction is from the north.

The average evaporation from March to November for the closest station (Elk City Lake Station, located approximately 55 miles east-northeast of the facility) was 51 inches per year, based on data from 1960 to 1992 (available period of record). No evaporation data is recorded for Arkansas City, Kansas.

3.0 DATA SUMMARY AND EVALUATION

A summary of the available soils characterization data for the Site is presented in Section 3.1, and an evaluation of the adequacy of the data for use in risk assessment is described in Section 3.2.

3.1 DATA SUMMARY

The RFI to address potential contamination in soil, groundwater, surface water, and sediment at the Site was conducted in 1990 (RSA, 1990). Additional delineation was conducted during the Phase II RFI in 1999 (Earth Tech, 2000) and the EUSSI in 2010 (MWH, 2011). Due to the age and limited extent of the 1990 RFI data, the 1990 data are excluded from this summary and they will not be used in the baseline HHRA for the Site. Decommissioning and removal of underground piping resulted in the movement of some of the PA soils that were sampled during the 1999 Phase II RFI. Although the analytical results for these reworked soils represent site concentrations, the corresponding sample location (i.e., spatial) information is no longer valid. As a result, the 1999 data corresponding to the reworked portions of the PA are not suitable for use in modeling exposures for individual EUs and, therefore, are excluded from this summary and will not be used in the baseline HHRA for the Site.

Summary statistics for relevant 1999 RFI soils data and 2010 EUSSI soils data for the PA (EUs 1 through 11), JSA, and CDL are summarized in Table 3-1 (for surface soil samples collected from 0 to 2 ft bgs) and Table 3-2 (for subsurface soil samples collected from 2 to 4 and 4 to 10 ft bgs). Summary statistics presented in Tables 3-1 and 3-2 include the number of samples; the number of detected results; and the maximum detected concentration, or the maximum analytical method detection limit (MDL), as available, or the method reporting limit (MRL) for non-detected results. Tables 3-1 and 3-2 also present proposed risk-based screening levels for the identification of soil COPCs for each EU, and results of a Site-wide preliminary cumulative risk screen for shallow and deep soils. The source and derivation of these risk-based screening levels, and the cumulative risk screening methods, are described in Section 4.1.1 of this HHRA Work Plan.

Constituents for which the maximum detected concentration, or the maximum MDL or MRL for non-detect results, exceed their respective risk-based screening level at any EU are bolded in Tables 3-1 and 3-2. For individual EUs, the maximum detected concentration of a constituent, or the maximum MDL or MRL for non-detect results for that constituent, are also bolded in Tables 3-1 and 3-2. The last two columns in Tables 3-1 and 3-2 present screening-level cancer risk and non-cancer hazard estimates based on the maximum detected concentration of a constituent, or the maximum MDL or MRL for non-detect results for that constituent, across all EUs. Screening-level cancer risk and non-cancer hazard estimates that are within one-tenth of the USEPA point of departure cancer risk criterion of 1×10^{-6}, or the acceptable non-cancer hazard criterion of 1, are bolded in Tables 3-1 and 3-2.

3.2 DATA EVALUATION

For analytical results to be usable for risk assessment, the sample collection, preparation, and

analytical methods should appropriately identify the constituent form or species; and the specified sample detection limit should be at or below a concentration that is associated with toxicologically relevant levels (e.g., published risk-based screening levels or action levels). The significance of analytical detection limits greater than such criteria will be evaluated on a case-by case basis and will be described in the Uncertainty Analysis section of the baseline HHRA Report. According to USEPA (1989a), only data collected and analyzed at a quality control (QC) level equivalent to USEPA Level III or higher (USEPA, 1988), meets appropriate usability criteria for evaluation in a quantitative HHRA. USEPA Level III data provide the following:

- Low detection limits
- A wide range of calibrated analyses
- Matrix recovery information
- Laboratory process control information
- Known precision and accuracy

The majority of the 1999 Phase II RFI and 2010 EUSSI soil characterization data are consistent with USEPA level III data quality requirements and are suitable for use in risk assessment. Several exceptions to these requirements are noted below.

Based on the data summaries and screening-level risk comparisons presented in Tables 3-1 and 3-2, it is evident that:

- The only metals with elevated concentrations in soil at the Site are arsenic, lead and mercury. The remaining metals do not appear to be elevated in Site soils based on a preliminary screening of Site-wide maximum detected concentrations, or maximum MRLs for non-detect results, to applicable risk-based screening levels.
- The only VOCs with significant concentrations in soils at the Site are benzene and ethylbenzene (in surface and subsurface soils) and 1,2,4-trimethylbenzene (in subsurface soils).
    - Although maximum detected concentrations of chloroform in three subsurface soil samples collected from the Site exceeds the screening level of 0.15 mg/kg, chloroform was only detected in 2 of 180 surface soil samples (Table 3-1), and 9 of 239 subsurface soil samples (Table 3-2).
    - Although maximum reporting limits for 1,2-dibromoethane (EDB), 1,2-dichloroethane and 1,4-dioxane (in surface and subsurface soils), and trichloroethene (TCE) (in subsurface soils) exceed their respective screening levels, the detection frequency for each of these constituents is very low. EDB was only detected in 1 of 180 shallow soil samples, (Table 3-1), and 1,2-dichloroethane and TCE were only detected in 1 and 3 of 239 subsurface soil samples, respectively (Table 3-2).
    - Based on matrix interference and sample dilution issues, it is highly unlikely that re-sampling for EDB, 1,2-dichloroethane, 1,4-dioxane, and TCE in Site soils will result in lower MRLs for these constituents.
    - All remaining VOCs were either non-detect, or detected at low concentrations, in surface and subsurface soils collected from the Site; and their associated

screening-level cancer risk or non-cancer hazard estimates are below one-tenth the USEPA point of departure cancer risk criterion of 1 x 10^{-6} and/or non-cancer hazard criterion of 1.

- SVOCs detected at significant concentrations in soils at the Site were benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, dibenz(a,h)-anthracene, indeno(1,2,3-cd)pyrene, 1-methylnaphthalene, and naphthalene (in surface and subsurface soils) and bis(2-ethylhexyl)phthalate (in subsurface soils).
    - 7,12-dimethylbenz(a)anthracene was non-detect in all surface and subsurface soil samples collected from the Site, and the maximum MRL for 7,12-dimethylbenz(a)anthracene was above the screening level for this constituent in every sample. Therefore, additional soil samples should be collected for the analysis of 7,12-dimethylbenz(a)anthracene at a lower MRL.
    - Although the maximum MRLs for 1,4-dichlorobenzene, 2,4-dinitrotoluene, and nitrobenzene were above their respective screening levels in surface and subsurface soils, these constituents were never detected at the Site, MRLs were not significantly elevated, and elevated MRLs did not occur in every EU.

In agency comments issued on the EUSSI Report (MWH, 2011), potential data gaps were identified for hexavalent chromium and 7,12-dimethylbenz(a)anthracene, as follows:

- Hexavalent chromium was not previously sampled for in Site soils and, therefore, is not known to be present or absent in soils at the Site. However, it is unlikely that hexavalent chromium is present at locations where total chromium is not elevated above ambient concentrations. This data gap will be addressed through hexavalent chromium sampling and analyses at locations where previous total chromium results exceed 37 mg/kg, which is the mean ambient soil concentration for chromium in the coterminous United States (Shacklette and Boerngen, 1984). If hexavalent chromium is detected in Site soils, the maximum detected concentration will be screened against one-tenth the USEPA RSL for Industrial Soil and a determination will be made regarding the potential need for additional characterization for hexavalent chromium.
- Concentrations of 7,12-dimethylbenz(a)anthracene in soil samples collected from the Site were non-detect; however, MRLs for this constituent were above the USEPA RSL for Industrial Soils.
- Although 7,12-dimethylbenz(a)anthracene was sampled for during previous investigations at the Refinery and was non-detect in all samples, the MRLs for this constituent were elevated above the USEPA RSL for Industrial Soil. Therefore, it is currently unknown whether 7,12-dimethylbenz(a)anthracene is present in soils at the Site at levels of toxicological concern. It's also currently unknown whether it is technically feasible to achieve MRLs or MDLs for this constituent in Site soils that are below the USEPA RSL for Industrial Soil using standard analytical methods. In order to fill this data gap, a limited number of soil samples will be collected from each EU and analyzed for 7,12-dimethylbenz(a)anthracene using USEPA Method 8270C SIM. If 7,12-dimethylbenz(a)anthracene is

detected in soil samples collected from the Site using analytical method 8270C SIM, additional samples will be collected for evaluation in the HHRA.

The above data gaps for hexavalent chromium and 7,12-dimethylbenz(a)anthracene will be addressed during a focused, Phase I Data Gap Soil Investigation in order to assess the presence or absence of these constituents in Site soils. If either of these constituents is detected in Site soils at significant concentrations, then additional characterization for these constituents will be performed during a broader Phase II Data Gap Soil Investigation. Details of these data gap soil investigations will be described in the Data Gap Characterization Work Plan. Table 3-3 presents a summary of the current data set and the data gaps are outlined in the proposed Phase I and Phase II Data Gap Soil Investigation sections of Table 3-3. Table 3-3 also identifies additional background sampling for arsenic during the proposed Phase I data gap sampling section.

In addition to the above data gaps, the data evaluation for the Site determined that there are limitations in (1) sample results for a given soil depth interval for some EUs, (2) the number of sample results available to derive exposure point concentrations (EPCs) for some EUs, and (3) the completeness of the available analyte list for some EUs.

For example, at EU 1 through EU 4, the JSA and the CDL, no sample results are available for deep (4 – 10 ft bgs) soils (Table 3-3). For these EUs, a total of four samples will be collected from the deep soil interval and analyzed for metals (arsenic, lead and mercury), VOCs and SVOCs (Table 3-3). Analytical results for the four samples from each EU will be combined with existing sample results for the medium soil depth range (2 – 4 ft bgs) during the calculation of EPCs for subsurface soil for that EU.

At EU 8 and the CDL, soil sampling results are only available for limited analyte lists for metals and SVOCs in shallow and medium depth soil (Tables 3-1 and 3-2). This limitation will be addressed by collecting eight surface (0 – 2 ft bgs) soil samples, four medium depth soil samples, and four deep soil samples for the analysis of metals and SVOCs (Table 3-3). Analytical results for the four medium depth soil samples and the four deep soil samples will be combined during the calculation of EPCs for subsurface soil for these EUs.

The above soil sampling activities will be performed during the Phase II Data Gap Soil Investigation, details of which will be described in the Data Gap Soil Investigation Work Plan.

4.0 HUMAN HEALTH RISK ASSESSMENT APPROACH

The methods to be used in the human health risk assessment (HHRA) for the Site are described in this section.

4.1 CONCEPTUAL SITE MODEL

The HHRA begins with the development of a site-specific conceptual site model (CSM). The site-specific CSM includes the identification of sources of contaminated media and constituents of potential concern (COPCs), evaluation of contaminant fate and transport pathways, potentially exposed populations, and potentially complete exposure pathways between contaminated media and receptors.

The following subsections describe the identification of medium-specific COPCs and the development of a site-specific CSM for the Site.

4.1.1 Contaminated Media and COPC Selection

Sources of contamination and potentially impacted media at the Site include historic spills and leaks from ASTs, process equipment, and SWMUs in the PA, leaching of metals and petroleum materials from decommissioned process equipment in the JSA, and releases from SWMUs in the CDL. Impacted media at the Site include surface and subsurface soil and groundwater. This HHRA will focus on impacted soils; impacted groundwater is being addressed through a separate corrective action process. The groundwater capture and treatment system that is currently in place is decreasing contaminant concentrations in groundwater; therefore, groundwater will be addressed at a later time, as necessary.

Identification of COPCs will be conducted in accordance with USEPA guidance (USEPA, 2009a). All surface and subsurface soil analytical results (i.e., maximum detected concentration for detected analytes and maximum reporting limit for non-detect analytes) will be screened against USEPA's Regional Screening Levels (RSLs) (USEPA, 2012a). According to USEPA (2009a), when more than one constituent is present in a Site medium, it is appropriate to calculate the screening-level, cumulative carcinogenic risk and noncarcinogenic hazard index (HI) for all detected constituents in that medium. The underlying basis for this calculation is that a constituent may be present at a maximum concentration that is lower than its respective screening level, but contribute to a *cumulative* carcinogenic risk or noncarcinogenic HI that is greater than acceptable risk management criteria due to impacts of multiple constituents on a given toxicological endpoint.

Cumulative effects screening for the Site will be performed by dividing the RSL by 10. The RSL for lead will not be divided by 10 because lead is evaluated through biokinetic modeling and is not included in the cumulative hazard estimate.

Analytes with a maximum detected concentration or a MDL or MRL below their respective screening level will be excluded from further evaluation in the baseline HHRA. Results for analytes with a MDL or MRL greater than their respective screening level will be evaluated

on an analyte-specific basis. Analytical results for metals will also be compared to site-specific background levels when site-specific background levels are available.

Proposed screening values for use at the Site are presented in Table 4-1. Preliminary Site-wide COPCs for shallow and deep (e.g., 0-2 ft bgs and 2-10 ft bgs, respectively) soil are indicated as bold constituent names in Tables 3-1 and 3-2. Preliminary COPCs for individual EUs are indicated by bolding of the maximum concentration within the data column for each EU. Formal COPC selection will be presented in the HHRA Report, following completion of Data Gap Characterization.

4.1.2 Human Health CSM

The CSM describes the nature of contaminant sources, current and future human receptors that may be present and the potential for complete exposure pathways between contaminant sources and receptors (USEPA, 1989a; 1989b). The CSM for current and hypothetical future human receptors is depicted graphically in Figure 4-1 and described below.

4.1.2.1 Contamination Sources and Transport Pathways

Sources of soil contamination include spills and leaks associated with refinery operations and active and decommissioned equipment; contaminants in soil have percolated over time to the water table. Potential transport pathways for Site media include soil transport as windblown dust or with surface water runoff, and groundwater discharge to surface water.

Windblown dust is expected to be a minimal source of potentially contaminated soil to inhabited off-Site locations because the prevailing wind direction is from the south, and the secondary prevailing wind direction is from the north. The area to the north is zoned heavy industrial, and acceptable concentrations at the Site will be protective of off-Site industrial receptors. Surface water runoff is controlled on-Site, and groundwater flow is to the northeast, away from the residential area. Groundwater discharge to the Walnut River is controlled by the groundwater treatment system that is currently in place.

4.1.2.2 Potential Receptors

Current use of the property is limited to small asphalt terminal consisting of a loading area and two ASTs. Additionally, the site is secured with a security fence and closed gate. It is assumed that all parcels will be redeveloped for commercial or industrial use, consistent with current land use and zoning, and that no individual developer will purchase a parcel smaller than five acres. Basement areas will be prohibited in future building construction. It is further assumed that installation of potable use wells will be prohibited, and that agricultural land use or other growth of edible plants for human consumption will be prohibited. These assumptions will be supported by future land use controls (LUCs) and/or deed restrictions, as necessary.

The Site is located adjacent to a residential area, a sports park, the Kaw Wildlife Area, and the Arkansas and Walnut Rivers. However, as described above, the only likely route for off-Site

transport is with groundwater discharge to the Walnut River in the absence of the groundwater capture and treatment system.

Based on the description above, potentially exposed groups include current and future on-Site commercial or industrial workers (i.e., existing Site MRP employees, and future commercial/industrial workers following redevelopment of the Site), future construction or utility workers, current and future off-Site recreational users of the Walnut River, off-Site residents, and off-Site recreational users of the Kaw Wildlife Area and the Arkansas River. Off-Site receptors are not likely to be exposed to Site-related contamination, due to the limited potential for off-Site transport described above. However, in the absence of the current groundwater capture and treatment system, there would be potential exposure for a future recreational user (RBA, 2005). Because a lapse in groundwater capture and treatment is unlikely to occur, this pathway will not be quantitatively evaluated in the HHRA. Exposure to Site media associated with workers at the asphalt terminal is expected to be minimal, and the more extensive exposure assumptions associated with future receptors will be protective of these current receptors. Therefore, only future on-Site commercial or industrial and construction or utility workers will be quantitatively evaluated. Although the location of the CDL outside the Walnut River and Arkansas River levee reduces its redevelopment potential, the same exposure assumptions will be used for all EUs as a conservative baseline assessment.

4.1.2.3 Potentially Complete Exposure Pathways

Future commercial or industrial workers and construction or utility workers will be exposed to contaminated soil via incidental ingestion, dermal contact, and inhalation of soil derived volatile compounds in outdoor ambient air and non-volatile contamination in wind-blown dust. Inhalation of soil derived volatile contaminants in above-ground indoor air is a potentially complete exposure pathway. However, due to the low levels of VOCs detected in soil and the high level of uncertainty associated with modeling vapor intrusion from soil matrix samples to indoor air (USEPA, 2002a), this pathway will be addressed as necessary during the groundwater portion of the corrective action process. Groundwater exposure is limited to inhalation of groundwater contaminants following vapor intrusion from groundwater to above ground indoor air. Installation of potable use wells will be prohibited, and exposure to groundwater contamination following discharge to surface water is not expected due to the groundwater capture and treatment system that is currently in place. The groundwater capture and treatment system that is currently in place is decreasing VOC concentrations in groundwater; therefore the potential future vapor intrusion exposure pathway will be addressed at a later time, as necessary.

Soil Exposure Pathways

Incidental ingestion of, and dermal contact with, soil and dust are potentially complete exposure pathways for human health receptors at the Site.

complete pathway for human receptors. Semi-volatile and non-volatile contaminants in sorbed to surface soil particles may be transported through ambient air with wind-blown dust and subsequently inhaled by future receptors at the Site

Indoor Air Transport and Exposure Pathways

Volatile constituents in soil can potentially migrate vertically to above ground indoor air within hypothetical future buildings. Indoor air concentrations following vapor migration from subsurface media is typically modeled with the Johnson and Ettinger vapor intrusion model (J&E Model). As noted above, groundwater treatment is currently reducing the concentrations of volatile contaminants in groundwater; therefore, the potential vapor intrusion from groundwater to indoor air pathway will be addressed at a later time, as necessary. Due to the low levels of VOCs detected in soil and the high level of uncertainty associated with modeling vapor intrusion from soil matrix samples to indoor air, potential vapor intrusion to indoor air exposures will not be modeled from soil matrix sampling results.

Surface Water, Sediment, and Biota Transport and Exposure Pathways

Surface water and sediment are located downgradient of the Site in the Walnut River. These media may become contaminated through discharge of impacted groundwater to surface water. Any contaminated surface water and sediment could lead to contamination of biota. Thus, exposure pathways for current and future recreational users of the Walnut River are incidental ingestion of surface water and sediment, dermal contact with surface water and sediment, and consumption of fish and other biota that has become contaminated. These pathways are considered to be currently incomplete because the groundwater capture and treatment system that is currently in place prevents discharge of contaminated groundwater to the river.

Groundwater Transport and Exposure Pathways

Installation and use of potable use groundwater wells will not be allowed in any future development at the Site, thus direct contact exposure pathways for groundwater are incomplete. Although the vapor intrusion to indoor air pathway is potentially complete for future industrial/commercial workers this pathway will not be addressed at this time, as described above.

4.2 BASELINE HUMAN HEALTH RISK ASSESSMENT METHODS

The baseline HHRA for the Site will be performed in accordance with the following USEPA guidance documents:

- Risk Assessment Guidance for Superfund (RAGS), Volume 1: Human Health Evaluation Manual, Part A (USEPA, 1989a).

- Human Health Evaluation manual, Supplemental Guidance: Standard Default Exposure Factors (USEPA, 1991).
- Final Exposure Assessment Guidelines (USEPA, 1992).
- Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites (USEPA, 2002b).
- Risk Assessment Guidance for Superfund (RAGS), Volume 1: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment (USEPA, 2004).
- Risk Assessment Guidance for Superfund (RAGS), Volume 1: Human Health Evaluation Manual, Part F, Supplemental Guidance for Inhalation Risk Assessment (USEPA, 2009a).
- Exposure Factors Handbook: 2011 Edition (USEPA, 2011a).

The general framework for conducting baseline HHRAs is provided in USEPA's *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Part A. Baseline Risk Assessment* (USEPA, 1989a). Consistent with these guidance documents, the baseline HHRA consists of the following five steps:

1. Exposure assessment
2. Exposure quantification
3. Toxicity assessment
4. Risk characterization
5. Uncertainty analysis

4.2.1 Exposure Assessment

The exposure assessment begins with development of a site-specific CSM; the human health CSM for the Site was described in Section 4.1.

Potential human receptors to be evaluated in the HHRA for the Site are future industrial or commercial workers and future utility or construction workers, as described in Section 4.1.2.2. Potentially complete exposure pathways for these receptors are presented graphically in Figure 4-1 and described in Section 4.1.2.3.

4.2.2 Exposure Quantification

Potential theoretical exposures and risks associated with the complete exposure pathways identified in Section 4.1.2.3 will be quantified according to the procedures described below. Methods to be used in the derivation of media EPCs, and procedures for quantifying theoretical exposure doses, are described in the following subsections. As described above, three areas, the PA, JSA, and CDL, of the Site will be evaluated in this HHRA. The larger PA will be further divided into five acre exposure units (EUs).

4.2.2.1 Deriving Exposure Point Concentrations

An EPC describes the level of a constituent in soil, sediment, water, or food to which a receptor is exposed (USEPA, 1989a, 2002c). As such, the EPC serves as the basis for quantifying pathway-specific theoretical exposure doses. For COPCs with sufficient quantity and quality of data, EPCs will be estimated as either the 95 percent upper confidence limit (% UCL) on the mean concentration, or, if the calculated 95% UCL on the mean concentration is greater than the maximum detected contaminant concentration, the maximum detected concentration will be used. If the number of samples or detected results is too small to calculate a UCL, the maximum detected result will be used as the EPC.

The 95% UCL on the mean concentration will be calculated using USEPA's ProUCL software version 4.01.01 (USEPA, 2011b). Distributions and 95% UCLs will be selected following methods provided in USEPA (2011b). Non-detect results will be handled as recommended by the program.

4.2.2.2 Calculating Exposure Doses

Exposure doses will be calculated according to methods and intake equations presented in USEPA's *Risk Assessment Guidance for Superfund* (RAGS; USEPA, 1989a). Equations for quantifying incidental ingestion, dermal contact, and inhalation exposures to COPCs in soil are presented below.

Incidental Ingestion of Soil

$$\text{Ingestion Intake for Soil/Dust (mg/kg-day)} = \frac{CS \times IR \times CF \times EF \times ED}{BW \times AT}$$

Where:

CS = concentration in soil (milligrams per kilogram [mg/kg])
IR = ingestion rate (mg soil/day)
CF = conversion factor (10^{-6} kilograms per milligram [kg/mg])
EF = exposure frequency (days/year)
ED = exposure duration (years)
BW = body weight (kilogram [kg])
AT = averaging time (period over which exposure is averaged – days)

Dermal Contact with Soil

$$\text{Dermal Intake for Soil/Dust (mg/Kg-day)} = \frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:

CS = concentration in soil (mg/kg)
CF = conversion factor (10^{-6} kg/mg)

SA = skin surface area exposed (square centimeters [cm^2])
AF = adherence factor of soil (milligrams per square centimeter per day [mg/cm^2-day])
ABS = skin absorption factor (unitless)
EF = exposure frequency (days/year)
ED = exposure duration (years)
BW = body weight (kg)
AT = averaging time (period over which exposure is averaged – days)

Inhalation of Ambient Air:

Non-carcinogenic inhalation of soil (mg/m^3) = $\frac{CS \times (1/PEF+1/VF) \times EF \times ED \times ET}{AT_{nc}}$
derived VOCs and dust

Where:

CS = concentration in soil (mg/kg)
PEF = particulate emission factor (m^3/kg)
VF = volatilization factor (m^3/kg)
EF = exposure frequency (days/year)
ED = exposure duration (years)
ET = exposure time (hrs/day)
AT_{nc} = non-carcinogenic averaging time (period over which exposure is averaged – days)

Carcinogenic inhalation of soil ($\mu g/m^3$) = $\frac{CS \times (1/PEF+1/VF) \times EF \times ED \times ET}{AT_c \times CF}$
derived VOCs and dust

Where:

CS = concentration in soil (mg/kg)
PEF = particulate emission factor (m^3/kg)
VF = volatilization factor (m^3/kg)
EF = exposure frequency (days/year)
ED = exposure duration (years)
AT_c = carcinogenic Averaging time (period over which exposure is averaged – days)
CF = conversion factor 1/1000 ($mg/\mu g$)

4.3 TOXICITY ASSESSMENT

The human health toxicity assessment will be performed in accordance with EPA Guidance (USEPA, 1989a). The primary sources of toxicity values to be used in the baseline HHRA will be follows:

- Integrated Risk Information System (IRIS) Database (USEPA, 2012b).

- USEPA RSL Table, November, 2012 (USEPA, 2012a).
- Provisional Peer Reviewed Toxicity Values (PPRTV) (USEPA, 2012c).
- Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997).
- Other USEPA documents, as applicable.
- California Environmental Protection Agency Toxicity Criteria Database (OEHHA, 2012).

Toxicity values to be used in the HHRA for the Site are presented in Table 4-3.

4.3.1 Constituent-Specific Assumptions

4.3.1.1 Dermal Toxicity

Although USEPA has developed toxicity criteria for the oral and inhalation routes of exposure, toxicity criteria for the dermal route of exposure have not been developed. USEPA has proposed a method for extrapolating oral toxicity criteria to the dermal route in *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)* (USEPA, 2004). This USEPA guidance states that the adjustment of the oral toxicity factor for dermal exposures is necessary only when the oral-gastrointestinal absorption efficiency of the constituent of interest is less than 50 percent (due to the variability inherent in absorption studies).

Adjustment of oral toxicity criteria to derive dermal reference doses (RfDs) and cancer slope factors (CSFs) will be conducted as follows:

$$\text{Dermal RfD} = \text{Oral RfD} \times ABS_{GI}$$

$$\text{Dermal CSF} = \text{Oral CSF} / ABS_{GI}$$

Where:

ABS_{GI} = oral absorption efficiency
CSF = cancer slope factor
RfD = reference dose

For constituents lacking an oral-gastrointestinal absorption efficiency value, the oral absorption efficiency is assumed to be 100 percent and the oral RfD or CSF will be used to estimate toxicity via the dermal route.

4.3.1.2 Lead Toxicity

Cause-and-effect relationships in humans have been correlated with concentrations of lead in blood. Therefore, at sites where lead is identified as a COPC, the preferred risk assessment approach is the estimation of human blood lead concentrations associated with an exposure situation. If lead is identified as a COPC at the Site, the Adult Lead Model (USEPA, 2009b) will be used to predict blood lead levels for future commercial or industrial and utility or construction workers exposed to lead in soil.

4.4 RISK CHARACTERIZATION

Risk characterization integrates the results of exposure and toxicity assessments to derive a quantitative evaluation of potential risks to current and future human receptors. Risk of developing cancer and the potential for noncarcinogenic effects are quantified separately by calculating an incremental lifetime cancer risk (ILCR) and hazard quotient (HQ), respectively, as described below.

Risk of developing cancer from ingestion of, and dermal contact with, contaminated soil and inhalation of contaminated soil derived dust will be estimated by summing the products of the oral exposure dose and CSF, the dermal exposure dose and CSF, and the ambient air inhalation exposure concentration and unit risk factor (URF) (USEPA, 1989a):

$$ILCR = (Oral\ Dose\ x\ Oral\ CSF) + (Dermal\ Dose\ x\ Dermal\ CSF) + (Inhalation\ Concentration\ x\ URF)$$

where the ILCR is unitless, the oral and dermal doses have units of (mg/kg-day), the oral and dermal CSFs have units of $(mg/kg\text{-}day)^{-1}$, the dust concentration has units of $(\mu g/m^3)$, and the URF has units of $(\mu g/m^3)^{-1}$.

The potential for noncarcinogenic effects as a result of ingestion of, and dermal contact with, contaminated soil is defined as the sum of the ratios of the oral and dermal exposure doses and ambient air inhalation concentration to the oral and dermal RfDs and inhalation RfC, respectively (USEPA, 1989):

$$HQ = \frac{Oral\ Dose}{Oral\ RfD} + \frac{Dermal\ Dose}{Dermal\ RfD} + \frac{Inhalation\ Concentration}{Inhalation\ RfC}$$

where the HQ is unitless, the oral and dermal doses and RfDs have units of (mg/kg-day), and the dust inhalation concentration and RfC have units of mg/m^3.

The EPA considers a cancer risk between 1×10^{-6} and 1×10^{-4} and noncancer HI of 1 as the point of departure for making risk management decisions concerning a site. Sites with associated cumulative cancer risk and noncancer HI estimates that exceed these criteria are proposed for further evaluation, or consideration of remedial alternatives. Sites with a cumulative cancer risk estimate below the 1×10^{-6} to 1×10^{-4} range, and a noncancer HI of less than 1, may be appropriate for conditional closure.

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TABLES

Table 3-1
Preliminary Screening of Shallow Soil Samples
MRP Properties Company, LLC - Arkansas City, Kansas

Constituent	Screening Level [a] (mg/kg)	EU 1			EU 2			EU 3			EU 4		
		Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)
Metals													
Antimony	41	6	5	3.9	8	6	4.0	10	8	2.5	9	6	1.2
Arsenic	0.16	13	13	**39**	14	14	**54**	14	14	**25**	14	14	**13**
Barium	19,000	6	6	162	8	8	755	10	10	261	9	9	183
Beryllium	200	6	6	0.85	8	8	0.9	10	10	0.96	9	9	0.77
Cadmium	80	6	5	0.40	8	7	1.7	10	8	2.6	9	6	0.61
Chromium	150,000	13	13	17	14	14	33.0	14	14	38	14	14	59
Lead	800	6	6	141	8	8	473	10	10	728	9	9	110
Mercury	4.3	6	5	0.12	8	8	**17**	10	8	0.34	9	4	0.29
Nickel	2,000	6	6	29	8	8	44	10	10	27	9	9	18
Selenium	510	6	5	1.8	7	3	0.7	9	4	0.86	8	3	0.89
Silver	510	6	1	0.19	8	1	0.2	10	0	0.16	9	0	0.16
Vanadium	520	6	6	34.7	8	8	31	10	10	39.3	9	9	33.6
Zinc	31,000	6	6	101	8	8	625	10	10	210	9	9	135
Cyanide	61	6	1	0.40	8	0	0.18	10	1	0.26	9	0	0.20
Volatile Organic Compounds													
Benzene	0.54	13	7	**0.68**	14	5	0.40	14	10	**15**	13	6	0.30
2-Butanone (MEK)	20,000	13	1	0.0099	14	3	0.14	14	4	0.060	13	1	0.018
Carbon disulfide	370	13	3	0.0020	14	5	0.020	14	6	0.026	13	5	0.0040
Chlorobenzene	140	13	0	0.0080	14	0	0.029	14	0	0.48	13	0	0.028
Chloroform	0.15	13	0	0.0080	14	0	0.045	14	1	0.014	13	0	0.043
1,2-Dibromoethane (EDB)	0.017	13	0	0.0080	14	0	**0.025** [e]	14	0	**0.48** [d]	13	0	**0.024** [h]
1,1-Dichloroethane	1.7	7	0	0.00030	6	0	0.05	4	0	0.00022	5	0	0.048
1,2-Dichloroethane	0.22	13	0	0.0080	14	0	0.025	14	0	**0.48** [g]	13	0	0.024
1,1-Dichloroethene	110	13	0	0.0080	14	0	0.050	14	0	0.48	13	0	0.048
1,4-Dioxane	1.7	13	0	0.82	14	0	**2.50** [e]	14	0	**48** [d]	13	0	**2.4** [h]
Ethylbenzene	2.7	13	3	0.0010	14	3	0.28	14	5	**6.2**	13	4	1.1
Methyl tert-butyl ether	22	7	0	0.00048	6	0	0.05	4	0	0.00036	5	0	0.047
Styrene	3,600	13	0	0.0080	14	0	0.026	14	0	0.48	13	0	0.025
Tetrachloroethene (PCE)	11	13	0	0.0080	14	0	0.027	14	0	0.48	13	0	0.025
Toluene	4,500	13	4	0.013	14	3	0.05	14	7	0.031	13	2	0.002
1,1,1-Trichloroethane	3,800	13	0	0.0080	14	0	0.020	14	0	0.48	13	0	0.019
Trichloroethene (TCE)	0.64	13	0	0.0080	14	0	0.023	14	0	0.48	13	0	0.022
1,2,4-Trimethylbenzene	26	13	1	0.0016	14	5	0.52	14	7	18	13	4	0.39
1,3,5-Trimethylbenzene	1,000	13	1	0.00055	14	5	0.15	14	5	11	13	4	0.76
o-Xylene	300	7	1	0.0011	6	1	0.13	4	0	0.00064	5	1	0.17
m-Xylene & p-Xylene	250	7	2	0.0025	6	1	0.12	4	0	0.0011	5	1	0.13
Xylenes (total)	270	13	6	0.18	14	4	0.24	14	5	2.5	13	2	0.30

Table 3-1
Preliminary Screening of Shallow Soil Samples
MRP Properties Company, LLC - Arkansas City, Kansas

Constituent	Screening Level [a] (mg/kg)	EU 1			EU 2			EU 3			EU 4		
		Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)
Semi-volatile Organic Compounds													
Acenaphthene	3,300	6	0	0.76	8	2	0.17	10	3	0.31	8	2	0.37
Anthracene	17,000	6	4	0.11	8	5	0.36	10	8	0.94	8	6	0.64
Benzo(a)anthracene	0.21	13	11	**0.42**	14	12	**9.7**	14	11	**2.8**	13	9	**1.4**
Benzo(a)pyrene	0.021	13	12	**0.85**	14	12	**7.6**	14	12	**0.84**	13	11	**0.82**
Benzo(b)fluoranthene	0.21	13	11	**2.2**	14	12	**3.9**	14	10	**0.56**	13	10	**0.57**
bis(2-Ethylhexyl)phthalate	12	6	4	6.7	8	4	7.2	10	5	2.5	8	5	2.8
Butyl benzyl phthalate	91	6	0	0.76	8	1	0.43	10	0	3.6	8	0	0.44
Chrysene	21	13	13	0.70	14	13	**24**	14	13	4.0	13	12	2.8
Dibenz(a,h)anthracene	0.021	13	10	**0.33**	14	9	**0.22**	14	6	**0.21**	13	7	**0.21**
1,2-Dichlorobenzene	980	6	0	0.76	8	0	3.5	10	0	3.6	8	0	0.44
1,4-Dichlorobenzene	1.2	6	0	0.76	8	0	**3.5** [f]	10	0	**3.6** [f]	8	0	0.44
7,12-Dimethylbenz(a)anthracene	0.00062	6	0	**0.76** [c]	8	0	**3.5** [c]	10	0	**3.6** [c]	8	0	**0.44** [c]
2,4-Dimethylphenol	1,200	6	0	0.76	8	0	3.5	10	0	3.6	8	0	0.44
2,4-Dinitrotoluene	0.55	6	0	**0.76** [d]	8	0	**3.5** [d]	10	0	**3.6** [g]	8	0	0.44
Di-n-butyl phthalate	6,200	6	1	0.036	8	3	0.035	10	3	0.044	8	2	0.13
Di-n-octyl phthalate	na	6	0	0.76	8	0	3.5	10	0	3.6	8	0	0.44
Fluoranthene	2,200	6	5	0.16	8	5	0.14	10	6	0.32	8	6	0.76
Fluorene	2,200	6	1	0.023	8	3	0.38	10	4	4.5	8	4	0.76
Indeno(1,2,3-cd)pyrene	0.21	13	11	**0.74**	14	10	**1.2**	14	7	**0.25**	13	9	**0.26**
1-Methylnaphthalene	5.3	6	6	0.20	8	6	2.9	10	7	**26**	8	6	0.74
2-Methylnaphthalene	220	6	6	0.25	8	6	4.8	10	8	20	8	7	0.31
2-Methylphenol	3,100	6	0	0.76	8	0	3.5	10	1	0.054	8	0	0.44
4-Methylphenol	6,200	6	0	0.76	8	1	0.025	10	1	0.26	8	1	0.039
Naphthalene	1.8	6	6	0.12	8	5	0.66	10	8	**6.6**	8	5	0.20
Nitrobenzene	2.4	6	0	0.76	8	0	**3.5** [f]	10	0	**3.6** [f]	8	0	0.44
Phenanthrene	na	6	6	0.53	8	7	3.3	10	9	14	8	7	6.3
Phenol	18,000	6	0	0.76	8	1	0.064	10	1	0.62	8	1	0.018
Pyrene	1,700	6	6	0.49	8	7	5.4	10	9	1.9	8	7	4.0
Pyridine	100	6	0	0.76	8	0	3.5	10	0	3.6	8	0	0.44

Table 3-1
Preliminary Screening of Shallow Soil Samples
MRP Properties Company, LLC - Arkansas City, Kansas

Constituent	Screening Level [a] (mg/kg)	EU 5			EU 6			EU 7			EU 8		
		Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)
Metals													
Antimony	41	4	2	0.64	4	4	2.9	5	4	19	--	--	--
Arsenic	0.16	13	13	**17**	13	13	**13**	13	13	**75**	13	12	**5.9**
Barium	19,000	4	4	104	4	4	119	5	5	174	--	--	--
Beryllium	200	4	4	0.47	4	4	0.67	5	5	0.66	--	--	--
Cadmium	80	4	3	0.25	4	4	2.3	5	5	1.0	--	--	--
Chromium	150,000	13	13	49	13	13	26	13	13	20	13	13	160
Lead	800	4	4	60	4	4	124	5	5	560	--	--	--
Mercury	4.3	4	2	0.12	4	2	0.26	5	3	0.15	--	--	--
Nickel	2,000	4	4	9.0	4	4	21	5	5	20	--	--	--
Selenium	510	4	0	0.39	4	2	0.53	4	2	0.69	--	--	--
Silver	510	4	0	0.14	4	0	0.14	5	3	1.2	--	--	--
Vanadium	520	4	4	18	4	4	24	5	5	023	--	--	--
Zinc	31,000	4	4	37	4	4	565	5	4	426	--	--	--
Cyanide	61	4	1	0.31	4	4	0.22	5	4	0.39	--	--	--
Volatile Organic Compounds													
Benzene	0.54	13	5	0.0020	13	4	**2.4**	13	6	**7.1**	13	1	0.00053
2-Butanone (MEK)	20,000	13	0	0.25	13	2	0.017	13	1	0.017	13	1	0.0030
Carbon disulfide	370	13	1	0.0070	13	4	0.040	13	3	0.0090	13	0	0.00047
Chlorobenzene	140	13	0	0.026	13	0	0.0060	13	0	0.028	13	0	0.00060
Chloroform	0.15	13	0	0.039	13	0	0.0060	13	0	0.042	13	0	0.00032
1,2-Dibromoethane (EDB)	0.017	13	0	**0.021**	13	0	0.0060	13	0	**0.023**	13	0	0.00058
1,1-Dichloroethane	1.7	9	0	0.043	9	0	0.00023	8	0	0.046	13	0	0.00023
1,2-Dichloroethane	0.22	13	0	0.021	13	0	0.0060	13	0	0.023	13	0	0.00078
1,1-Dichloroethene	110	13	0	0.043	13	0	0.0060	13	0	0.046	13	0	0.00066
1,4-Dioxane	1.7	13	0	**2.1**	13	0	0.59	13	0	**2.3**	13	0	0.062
Ethylbenzene	2.7	13	1	0.0010	13	0	0.0060	13	3	0.016	13	0	0.00075
Methyl tert-butyl ether	22	9	0	.043	9	0	0.00038	8	0	0.046	13	0	0.00038
Styrene	3,600	13	0	0.022	13	0	0.0060	13	1	0.00068	13	0	0.00070
Tetrachloroethene (PCE)	11	13	0	0.023	13	0	0.0060	13	0	0.025	13	1	0.0010
Toluene	4,500	13	2	0.002	13	1	0.0020	13	3	0.12	13	1	0.00063
1,1,1-Trichloroethane	3,800	13	0	0.017	13	0	0.0060	13	0	0.018	13	0	0.00058
Trichloroethene (TCE)	0.64	13	0	0.020	13	0	0.0060	13	0	0.021	13	0	0.00026
1,2,4-Trimethylbenzene	26	13	2	0.030	13	2	0.024	13	4	0.11	13	0	0.00065
1,3,5-Trimethylbenzene	1,000	13	0	0.033	13	1	0.017	13	3	5.6	13	0	0.00063
o-Xylene	300	9	0	0.030	9	0	0.00067	8	1	0.021	13	0	0.00068
m-Xylene & p-Xylene	250	9	0	0.066	9	0	0.0011	8	1	0.058	13	0	0.0012
Xylenes (total)	270	13	1	0.0020	13	1	0.018	13	5	0.079	13	0	0.00068

Table 3-1
Preliminary Screening of Shallow Soil Samples
MRP Properties Company, LLC - Arkansas City, Kansas

Constituent	Screening Level [a] (mg/kg)	EU 5			EU 6			EU 7			EU 8		
		Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)
Semi-volatile Organic Compounds													
Acenaphthene	3,300	4	1	0.072	4	2	3.1	5	0	3.8	--	--	--
Anthracene	17,000	4	3	0.27	4	3	1.3	5	2	0.57	--	--	--
Benzo(a)anthracene	0.21	13	13	**10**	13	9	**6.8**	13	8	**0.58**	13	13	**0.71**
Benzo(a)pyrene	0.021	13	13	**9.1**	13	12	**6.9**	13	11	**0.50**	13	13	**0.53**
Benzo(b)fluoranthene	0.21	13	13	**5.5**	13	11	**4.3**	13	12	**0.62**	13	13	**0.65**
bis(2-Ethylhexyl)phthalate	12	4	3	2.4	4	4	11	5	5	10	--	--	--
Butyl benzyl phthalate	91	4	0	0.79	4	0	3.9	5	0	3.8	--	--	--
Chrysene	21	13	13	**24**	13	12	13	13	11	3.0	13	13	1.5
Dibenz(a,h)anthracene	0.021	13	11	**1.8**	13	11	**2.2**	13	10	**0.17**	13	13	**0.21**
1,2-Dichlorobenzene	980	4	0	0.79	4	0	3.9	5	0	3.8	--	--	--
1,4-Dichlorobenzene	1.2	4	0	0.79	4	0	**3.9** [f]	5	0	**3.8** [d]	--	--	--
7,12-Dimethylbenz(a)anthracene	0.00062	4	0	**0.79** [c]	4	0	**3.9** [c]	5	0	**3.8** [c]	--	--	--
2,4-Dimethylphenol	1,200	4	0	0.79	4	0	3.9	5	0	3.8	--	--	--
2,4-Dinitrotoluene	0.55	4	0	**0.79** [g]	4	0	**3.9** [f]	5	0	**3.8** [d]	--	--	--
Di-n-butyl phthalate	6,200	4	0	0.79	4	0	3.9	5	1	0.018	--	--	--
Di-n-octyl phthalate	na	4	0	0.79	4	0	3.9	5	0	3.8	--	--	--
Fluoranthene	2,200	4	3	0.38	4	2	0.87	5	2	0.25	--	--	--
Fluorene	2,200	4	1	0.099	4	3	5.5	5	2	1.0	--	--	--
Indeno(1,2,3-cd)pyrene	0.21	13	12	**1.3**	13	11	**2.3**	13	11	0.19	13	13	**0.24**
1-Methylnaphthalene	5.3	4	3	3.6	4	4	**33**	5	3	**10**	--	--	--
2-Methylnaphthalene	220	4	3	0.27	4	4	44	5	3	12	--	--	--
2-Methylphenol	3,100	4	0	0.79	4	0	3.9	5	0	3.8	--	--	--
4-Methylphenol	6,200	4	0	0.79	4	0	3.9	5	0	3.8	--	--	--
Naphthalene	1.8	4	3	**2.3**	4	4	**13**	5	4	**8.8**	--	--	--
Nitrobenzene	2.4	4	0	0.79	4	0	**3.9** [f]	5	0	**3.8** [d]	--	--	--
Phenanthrene	na	4	4	1.5	4	4	18	5	3	3.3	--	--	--
Phenol	18,000	4	0	0.79	4	0	3.9	5	0	3.8	--	--	--
Pyrene	1,700	4	4	2.0	4	3	2.9	5	3	3.5	--	--	--
Pyridine	100	4	0	0.79	4	0	3.9	5	0	3.8	--	--	--

Table 3-1
Preliminary Screening of Shallow Soil Samples
MRP Properties Company, LLC - Arkansas City, Kansas

Constituent	Screening Level [a] (mg/kg)	EU 9			EU 10			EU 11			EU JSA		
		Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)
Metals													
Antimony	41	3	1	0.37	3	2	0.97	5	3	1.9	12	10	32
Arsenic	0.16	13	12	**7.9**	13	13	**10**	13	13	**8.5**	26	26	**35**
Barium	19,000	3	3	117	3	3	81	5	5	84	12	12	122
Beryllium	200	3	3	0.67	3	3	0.62	5	5	0.45	12	12	1
Cadmium	80	3	3	0.28	3	3	0.31	5	5	0.70	12	11	2.9
Chromium	150,000	13	13	59	13	13	220	13	13	29	26	26	25
Lead	800	3	3	92	3	3	31	5	5	123	12	12	76
Mercury	4.3	3	1	0.21	3	1	0.11	5	5	0.39	12	11	3
Nickel	2,000	3	3	11	3	3	18	5	5	12	12	12	74
Selenium	510	3	1	0.42	3	0	0.37	3	0	0.37	12	1	0
Silver	510	3	0	0.13	3	0	0.13	5	0	0.14	12	0	0
Vanadium	520	3	3	21	3	3	56	5	5	28	12	12	118
Zinc	31,000	3	3	65	3	3	95	5	5	129	12	12	78
Cyanide	61	3	1	0.18	3	2	0.81	5	1	0.80	11	0	0.22
Volatile Organic Compounds													
Benzene	0.54	13	7	0.091	13	7	0.068	13	4	0.093	26	3	0.014
2-Butanone (MEK)	20,000	13	2	0.0078	13	1	0.0020	13	0	0.0070	26	4	0.077
Carbon disulfide	370	13	3	0.0020	13	2	0.014	13	1	0.0020	26	4	0.0050
Chlorobenzene	140	13	0	0.0070	13	0	0.027	13	0	0.0070	26	0	0.0070
Chloroform	0.15	13	0	0.0070	13	0	0.041	13	1	0.013	26	0	0.0070
1,2-Dibromoethane (EDB)	0.017	13	1	0.0018	13	0	**0.022**	13	0	0.0070	26	0	0.0070
1,1-Dichloroethane	1.7	10	0	0.00024	10	0	0.045	8	0	0.00022	14	0	0.00022
1,2-Dichloroethane	0.22	13	0	0.0070	13	0	0.022	13	0	0.0070	26	0	0.0070
1,1-Dichloroethene	110	13	0	0.0070	13	0	0.045	13	0	0.0070	26	0	0.0070
1,4-Dioxane	1.7	13	0	0.67	13	0	**2.2**	13	0	0.70	26	0	0.72
Ethylbenzene	2.7	13	4	0.22	13	5	0.21	13	2	0.48	26	2	0.021
Methyl tert-butyl ether	22	10	0	0.00038	10	0	0.044	8	0	0.00036	14	0	0.00035
Styrene	3,600	13	0	0.0070	13	0	0.023	13	0	0.0070	26	0	0.0070
Tetrachloroethene (PCE)	11	13	1	0.0069	13	1	0.00096	13	0	0.0070	26	0	0.0070
Toluene	4,500	13	5	0.039	13	5	0.058	13	4	0.031	26	3	0.021
1,1,1-Trichloroethane	3,800	13	0	0.0070	13	0	0.018	13	0	0.0070	26	0	0.0070
Trichloroethene (TCE)	0.64	13	0	0.0070	13	0	0.020	13	0	0.0070	26	0	0.0070
1,2,4-Trimethylbenzene	26	13	6	1.0	13	5	0.64	13	3	4.5	26	3	0.11
1,3,5-Trimethylbenzene	1,000	13	6	0.38	13	3	0.37	13	3	2.6	26	2	0.12
o-Xylene	300	10	4	0.30	10	3	0.46	8	1	0.043	14	0	0.00063
m-Xylene & p-Xylene	250	10	3	0.70	10	4	0.13	8	1	0.0025	14	0	0.0011
Xylenes (total)	270	13	4	1.0	13	6	0.58	13	3	0.67	26	2	0.057

Table 3-1
Preliminary Screening of Shallow Soil Samples
MRP Properties Company, LLC - Arkansas City, Kansas

Constituent	Screening Level [a] (mg/kg)	EU 9			EU 10			EU 11			EU JSA		
		Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)
Semi-volatile Organic Compounds													
Acenaphthene	3,300	3	0	0.36	3	1	0.32	5	2	0.15	11	5	1.1
Anthracene	17,000	3	3	0.25	3	1	0.86	5	3	0.35	12	10	6.9
Benzo(a)anthracene	0.21	13	12	**1.9**	13	12	**4.3**	13	12	**1.8**	26	25	**45**
Benzo(a)pyrene	0.021	13	13	**2.6**	13	11	**2.4**	13	13	**3.8**	26	25	**29**
Benzo(b)fluoranthene	0.21	13	13	**2.5**	13	11	**4.2**	13	13	**2.5**	26	25	**27**
bis(2-Ethylhexyl)phthalate	12	3	2	1.2	3	3	2.2	5	4	2.2	11	3	0.73
Butyl benzyl phthalate	91	3	0	0.36	3	0	0.35	5	0	0.38	11	0	18
Chrysene	21	13	13	5.3	13	13	4.2	13	13	10	26	25	**97**
Dibenz(a,h)anthracene	0.021	13	12	**1.4**	13	9	**0.43**	13	12	**1.4**	26	26	**15**
1,2-Dichlorobenzene	980	3	0	0.36	3	0	0.35	5	0	0.38	11	0	18
1,4-Dichlorobenzene	1.2	3	0	0.36	3	0	0.35	5	0	0.38	11	0	**18** [j]
7,12-Dimethylbenz(a)anthracene	0.00062	3	0	**0.36** [c]	3	0	**0.35** [c]	5	0	**0.38** [c]	11	0	**18** [c]
2,4-Dimethylphenol	1,200	3	1	0.029	3	0	0.35	5	0	0.38	12	1	0.018
2,4-Dinitrotoluene	0.55	3	0	0.36	3	0	0.35	5	0	0.38	11	0	**18** [j]
Di-n-butyl phthalate	6,200	3	2	0.021	3	0	0.35	5	3	0.038	11	2	0.31
Di-n-octyl phthalate	na	3	0	0.36	3	0	0.35	5	0	0.38	11	0	18
Fluoranthene	2,200	3	3	0.57	3	1	3.5	5	4	0.39	12	12	20
Fluorene	2,200	3	1	0.050	3	1	0.32	5	4	1.2	11	9	1.3
Indeno(1,2,3-cd)pyrene	0.21	13	13	**1.3**	13	11	**1.1**	13	12	**0.93**	26	25	**12**
1-Methylnaphthalene	5.3	3	2	0.11	3	1	0.030	5	5	**6.7**	12	11	4.6
2-Methylnaphthalene	220	3	2	0.38	3	1	0.046	5	5	4.1	12	11	12
2-Methylphenol	3,100	3	0	0.36	3	0	0.35	5	0	0.38	12	0	18
4-Methylphenol	6,200	3	1	0.073	3	0	0.35	5	0	0.38	12	0	18
Naphthalene	1.8	3	2	0.15	3	1	0.069	5	5	1.6	12	11	**5.7**
Nitrobenzene	2.4	3	0	0.36	3	0	0.35	5	0	0.38	11	0	**18** [d]
Phenanthrene	na	3	3	2.6	3	3	2.7	5	5	2.0	12	12	100
Phenol	18,000	3	0	0.36	3	0	0.35	5	0	0.38	12	0	18
Pyrene	1,700	3	3	1.7	3	3	5.9	5	5	1.6	12	12	62
Pyridine	100	3	0	0.36	3	0	0.35	5	0	0.38	11	0	18

Table 3-1
Preliminary Screening of Shallow Soil Samples
MRP Properties Company, LLC - Arkansas City, Kansas

Constituent	Screening Level [a] (mg/kg)	EU CDL			Shallow Soils Data Summary for 13 EUs				Shallow Soils Risk Screen [k]	
		Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Site Maximum Value (mg/kg)	Site Number of Samples	Site Number of Detects	Percent Detect	Screening Cancer Risk Estimate	Screening Noncancer Hazard Estimate
Metals										
Antimony	41	--	--	--	32	69	51	73.9%		0.078
Arsenic	0.16	9	9	**44**	75	181	179	98.9%	**4.7E-05**	
Barium	19,000	--	--	--	755	69	69	100.0%		0.0040
Beryllium	200	--	--	--	0.96	69	69	100.0%		0.00048
Cadmium	80	--	--	--	2.9	69	60	87.0%		0.0036
Chromium	150,000	9	9	390	390	181	181	100.0%		0.00026
Lead	800	9	9	660	728	78	78	100.0%		**0.91**
Mercury	4.3	--	--	--	16.5	69	50	72.5%		**0.38**
Nickel	2,000	--	--	--	73.7	69	69	100.0%		0.0037
Selenium	510	--	--	--	1.8	63	21	33.3%		0.00035
Silver	510	--	--	--	1.2	69	5	7.2%		0.00024
Vanadium	520	--	--	--	118	69	69	100.0%		0.023
Zinc	31,000	--	--	--	625	69	68	98.6%		0.0020
Cyanide	61	--	--	--	0.81	68	15	22.1%		0.0013
Volatile Organic Compounds										
Benzene	0.54	9	3	0.069	15	180	68	37.8%	**2.8E-06**	
2-Butanone (MEK)	20,000	9	3	0.036	0.25	180	23	12.8%		0.0000013
Carbon disulfide	370	9	0	0.065	0.065	180	37	20.6%		0.000018
Chlorobenzene	140	9	0	0.031	0.48	180	0	0.0%		0.00034
Chloroform	0.15	9	0	0.047	0.047	180	2	1.1%	3.1E-08	
1,2-Dibromoethane (EDB)	0.017	9	0	**0.025** [h]	0.48	180	1	0.6%	**2.8E-06**	
1,1-Dichloroethane	1.7	9	0	0.051	0.051	112	0	0.0%	3.0E-09	
1,2-Dichloroethane	0.22	8	0	0.025	0.48	179	0	0.0%	**2.2E-07**	
1,1-Dichloroethene	110	9	0	0.051	0.48	180	0	0.0%		0.00044
1,4-Dioxane	1.7	9	0	**2.5** [h]	48	180	0	0.0%	**2.8E-06**	
Ethylbenzene	2.7	9	3	1.6	6.2	180	35	19.4%	**2.3E-07**	
Methyl tert-butyl ether	22	9	0	0.051	0.051	112	0	0.0%	2.3E-10	
Styrene	3,600	9	1	0.022	0.48	180	2	1.1%		0.000013
Tetrachloroethene (PCE)	11	9	0	0.027	0.48	180	3	1.7%	4.4E-09	
Toluene	4,500	9	3	0.10	0.12	180	43	23.9%		0.0000027
1,1,1-Trichloroethane	3,800	9	0	0.020	0.48	180	0	0.0%		0.000013
Trichloroethene (TCE)	0.64	9	0	0.023	0.48	180	0	0.0%	7.5E-08	
1,2,4-Trimethylbenzene	26	9	4	0.53	18	180	46	25.6%		0.069
1,3,5-Trimethylbenzene	1,000	9	4	0.48	11	180	37	20.6%		0.0011
o-Xylene	300	9	3	0.19	0.46	112	15	13.4%		0.00015
m-Xylene & p-Xylene	250	9	3	0.13	0.7	112	16	14.3%		0.00028
Xylenes (total)	270	9	3	0.28	2.5	180	42	23.3%		0.00093

Table 3-1
Preliminary Screening of Shallow Soil Samples
MRP Properties Company, LLC - Arkansas City, Kansas

Constituent	Screening Level [a] (mg/kg)	EU CDL			Shallow Soils Data Summary for 13 EUs				Shallow Soils Risk Screen [k]	
		Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Site Maximum Value (mg/kg)	Site Number of Samples	Site Number of Detects	Percent Detect	Screening Cancer Risk Estimate	Screening Noncancer Hazard Estimate
Semi-volatile Organic Compounds										
Acenaphthene	3,300	--	--	--	3.8	67	18	26.9%		0.00012
Anthracene	17,000	--	--	--	6.9	68	48	70.6%		0.000041
Benzo(a)anthracene	0.21	9	9	**8.6**	45	180	156	86.7%	**2.1E-05**	
Benzo(a)pyrene	0.021	9	9	**7.9**	29	180	167	92.8%	**1.4E-04**	
Benzo(b)fluoranthene	0.21	9	9	**9.2**	27	180	163	90.6%	**1.3E-05**	
bis(2-Ethylhexyl)phthalate	12	--	--	--	11	67	42	62.7%	9.2E-08	
Butyl benzyl phthalate	91	--	--	--	18	67	1	1.5%	2.0E-08	
Chrysene	21	9	9	20	97	180	173	96.1%	**4.6E-07**	
Dibenz(a,h)anthracene	0.021	9	9	**2.6**	15	180	145	80.6%	**7.1E-05**	
1,2-Dichlorobenzene	980	--	--	--	18	67	0	0.0%		0.0018
1,4-Dichlorobenzene	1.2	--	--	--	18	67	0	0.0%	**1.5E-06**	
7,12-Dimethylbenz(a)anthracene	0.00062	--	--	--	18	67	0	0.0%	**2.9E-03**	
2,4-Dimethylphenol	1,200	--	--	--	3.9	68	2	2.9%		0.00033
2,4-Dinitrotoluene	0.55	--	--	--	18	67	0	0.0%	**3.3E-06**	
Di-n-butyl phthalate	6,200	--	--	--	3.9	67	17	25.4%		0.000063
Di-n-octyl phthalate	na	--	--	--	18	67	0	0.0%	na	na
Fluoranthene	2,200	--	--	--	20	68	49	72.1%		0.00091
Fluorene	2,200	--	--	--	5.5	67	33	49.3%		0.00025
Indeno(1,2,3-cd)pyrene	0.21	9	9	**4.0**	12	180	154	85.6%	**5.7E-06**	
1-Methylnaphthalene	5.3	--	--	--	33	68	54	79.4%	**6.2E-07**	
2-Methylnaphthalene	220	--	--	--	44	68	56	82.4%		0.020
2-Methylphenol	3,100	--	--	--	18	68	1	1.5%		0.00058
4-Methylphenol	6,200	--	--	--	18	68	4	5.9%		0.00029
Naphthalene	1.8	--	--	--	13	68	54	79.4%	**7.2E-07**	
Nitrobenzene	2.4	--	--	--	18	67	0	0.0%	**7.5E-07**	
Phenanthrene	na	--	--	--	100	68	63	92.6%	na	na
Phenol	18,000	--	--	--	18	68	3	4.4%		0.00010
Pyrene	1,700	--	--	--	62	68	62	91.2%		0.0036
Pyridine	100	--	--	--	18	67	0	0.0%		0.018

Table 3-1
Preliminary Screening of Shallow Soil Samples
MRP Properties Company, LLC - Arkansas City, Kansas

Notes:

Bolding of a chemical name indicates that the screening level was exceeded by one or more detected concentrations in one or more exposure units; **bolding** of a maximum value indicates that the screening level was exceeded by that maximum value. **Bolding** of a screening level risk or hazard indicates exceedance of a cancer risk of $1x10^{-7}$ or HQ of 0.1.

bold italics of a chemical name indicates that for one or more exposure units, the analyte was not detected, and either sample RL exceeded the screening level in one or more samples and MDLs were unavailable for those samples, or both the sample RL and the MDL exceeded the screening level.

-- - analyte not analyzed in the indicated year.

mg/kg - milligrams per kilogram

na - not available; no EPA Regional Screening Level is available for this chemical

[a] Screening value is equal to1/10th of the US EPA Industrial Soil Regional Screening Level (RSL) for carcinogenic and noncarcinogenic chemicals to account for potential cumulative effects.

[b] Maximum value is the greatest detected value, or, if the analyte was not detected, the maximum analytical method detection limit (MDL), where available, or the maximum sample reporting limit (RL).

[c] The analyte was non detect and the sample RL exceeded the screening level in all samples; MDLs are unavailable for these samples

[d] The analyte was non detect and the sample RL exceeded the screening level in three samples; MDLs are unavailable for these three samples.

[e] The analyte was non detect and the sample RL and analytical MDL exceeded the screening level in three samples.

[f] The analyte was non detect and the sample RL exceeded the screening level in one sample; an MDL is not available for this sample.

[g] The analyte was non detect and the sample RL exceeded the screening level in two samples; MDLs are unavailable for these two samples.

[j] The analyte was non detect and the sample RL exceeded the screening level in five samples; MDLs are unavailable for these five samples.

[k] The screening-level cancer risk estimate or noncancer HQ estimate is bolded if it exceeds a cancer risk of 1x10-7 or HQ of 0.1, respectively, to account for potential cumulative effects.

Table 3-2
Preliminary Screening of Deep Soil Samples
MRP Properties Company, LLC - Arkansas City, Kansas

Constituent	Screening Level [a] (mg/kg)	EU 1			EU 2			EU 3			EU 4		
		Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)
Metals													
Antimony	41	6	4	6.9	8	5	6.1	11	5	1.7	9	5	3.0
Arsenic	0.16	13	13	**10**	14	14	**11**	15	15	**37**	14	14	**33**
Barium	19,000	6	6	196	8	8	207	11	11	281	9	9	211
Beryllium	200	6	6	0.95	8	8	1.2	11	11	1.2	9	8	0.95
Cadmium	80	6	4	1.6	8	5	0.42	11	6	0.52	9	7	1.8
Chromium	150,000	13	13	18	14	14	19	15	15	18	14	14	25
Lead	800	6	6	152	8	8	213	11	11	331	9	9	**993**
Mercury	4.3	6	2	0.21	8	4	0.090	10	2	0.26	8	4	1.0
Nickel	2,000	6	6	28	8	8	20	11	11	24	9	9	38
Selenium	510	6	3	1.8	7	6	0.50	10	3	1.1	7	1	2.0
Silver	510	6	1	0.39	8	0	0.15	11	0	0.16	9	2	0.36
Vanadium	520	6	6	34	8	8	54	11	11	56	9	9	34
Zinc	31,000	6	6	399	8	8	85	11	11	86	9	9	875
Cyanide	61	6	0	0.18	8	0	0.19	11	1	1.6	9	2	0.34
Volatile Organic Compounds													
Benzene	0.54	13	7	**1.4**	14	10	**6.0**	14	10	**12**	14	8	**11**
2-Butanone (MEK)	20,000	13	2	0.032	14	0	0.55	14	3	0.099	14	3	0.017
Carbon disulfide	370	13	1	0.011	14	5	0.014	14	6	4.5	14	7	0.034
Chlorobenzene	140	13	0	0.49	14	0	0.55	14	0	1.0	14	0	0.029
Chloroform	0.15	13	0	**0.49** [c]	14	0	**0.55** [e]	14	3	**2.0**	14	1	0.049
1,2-Dibromoethane (EDB)	0.017	13	0	**0.49** [c]	14	0	**0.55** [f]	14	0	**1.0** [h]	14	0	**0.025** [k]
1,1-Dichloroethane	1.7	7	0	0.00023	6	0	0.054	4	0	0.060	5	0	0.050
1,2-Dichloroethane	0.22	13	0	**0.49** [c]	14	0	**0.55** [e]	14	0	**1.0** [i]	14	0	0.025
1,1-Dichloroethene	110	13	0	0.49	14	0	0.55	14	0	1.0	14	0	0.050
1,4-Dioxane	1.7	13	0	**49** [c]	14	0	**55** [f]	14	0	**100** [h]	14	0	**2.5** [k]
Ethylbenzene	2.7	13	2	0.19	14	5	0.68	14	9	**21**	14	3	**26**
Methyl tert-butyl ether	22	7	0	0.00037	6	0	0.053	4	0	0.060	5	0	0.049
Styrene	3,600	13	0	0.49	14	0	0.55	14	0	1.0	14	0	0.026
Tetrachloroethene (PCE)	11	13	0	0.49	14	0	0.55	14	0	1.0	14	0	0.027
Toluene	4,500	13	3	0.0039	14	7	1.2	14	7	0.96	14	9	1.5
1,1,1-Trichloroethane	3,800	13	0	0.49	14	0	0.55	14	0	1.0	14	0	0.020
Trichloroethene (TCE)	0.64	13	0	0.49	14	0	0.55	14	0	**1.0** [j]	14	0	0.023
1,2,4-Trimethylbenzene	26	13	3	0.0025	14	8	3.6	14	7	**36**	14	7	8.7
1,3,5-Trimethylbenzene	1,000	13	3	0.010	14	4	0.35	14	8	15	14	6	20
o-Xylene	300	7	2	0.0062	6	3	0.63	4	2	0.27	5	2	1.9
m-Xylene & p-Xylene	250	7	2	0.020	6	2	0.66	4	2	0.65	5	2	11
Xylenes (total)	270	13	4	0.026	14	7	1.1	14	10	35	14	6	13

Table 3-2
Preliminary Screening of Deep Soil Samples
MRP Properties Company, LLC - Arkansas City, Kansas

Constituent	Screening Level [a] (mg/kg)	EU 1			EU 2			EU 3			EU 4		
		Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)
Semi-volatile Organic Compounds													
Acenaphthene	3,300	6	0	0.79	8	2	0.30	10	4	0.57	9	2	0.035
Anthracene	17,000	6	2	0.11	8	4	0.73	10	5	0.76	9	5	0.38
Benzo(a)anthracene	0.21	13	7	0.14	14	10	**3.1**	14	8	0.13	14	8	**0.39**
Benzo(a)pyrene	0.021	13	11	**0.66**	14	10	**4.8**	14	6	**2.5**	14	8	**0.31**
Benzo(b)fluoranthene	0.21	13	8	**0.29**	14	10	**2.6**	14	5	**1.4**	14	8	**0.26**
bis(2-Ethylhexyl)phthalate	12	6	6	4.0	8	6	**16**	10	8	9.3	9	7	**15**
Butyl benzyl phthalate	91	6	0	0.79	8	0	4.2	10	0	3.8	9	0	8.8
Chrysene	21	13	9	0.42	14	12	8.5	14	11	1.3	14	12	0.86
Dibenz(a,h)anthracene	0.021	13	7	**0.31**	14	6	**1.6**	14	1	**0.92**	14	6	**0.19**
1,2-Dichlorobenzene	980	6	0	0.79	8	0	4.2	10	0	3.8	9	0	8.8
1,4-Dichlorobenzene	1.2	6	0	0.79	8	0	**4.2** [g]	10	0	**3.8** [j]	9	0	**8.8** [c]
7,12-Dimethylbenz(a)anthracene	0.00062	6	0	**0.79** [d]	8	0	**4.2** [d]	10	0	**3.8** [d]	9	0	**8.8** [d]
2,4-Dimethylphenol	1,200	6	0	0.79	8	0	4.2	10	0	3.8	9	1	0.078
2,4-Dinitrotoluene	0.55	6	0	**0.79** [c]	8	0	**4.2** [g]	10	0	**3.8** [g]	9	0	**8.8** [c]
Di-n-butyl phthalate	6,200	6	1	0.031	8	2	0.028	10	4	0.056	9	2	0.050
Di-n-octyl phthalate	na	6	0	0.79	8	0	4.2	10	0	3.8	9	0	8.8
Fluoranthene	2,200	6	2	0.058	8	3	0.55	10	2	0.14	9	4	0.28
Fluorene	2,200	6	1	0.020	8	4	0.57	10	8	4.8	9	6	1.0
Indeno(1,2,3-cd)pyrene	0.21	13	9	**0.41**	14	7	**1.1**	14	3	**1.1**	14	7	0.15
1-Methylnaphthalene	5.3	6	3	0.27	8	5	4.9	10	8	**30**	9	8	**42**
2-Methylnaphthalene	220	6	3	0.29	8	6	7.7	10	7	43	9	8	12
2-Methylphenol	3,100	6	0	0.79	8	0	4.2	10	0	3.8	9	0	8.8
4-Methylphenol	6,200	6	0	0.79	8	0	4.2	10	1	0.98	9	1	0.11
Naphthalene	1.8	6	3	0.13	8	5	1.1	10	8	**9.4**	9	6	**27**
Nitrobenzene	2.4	6	0	0.79	8	0	**4.2** [g]	10	0	**3.8** [c]	9	0	**8.8** [c]
Phenanthrene	na	6	2	0.37	8	6	5.3	10	9	16	9	8	2.9
Phenol	18,000	6	1	0.030	8	1	0.022	10	1	0.12	9	0	8.8
Pyrene	1,700	6	3	0.59	8	7	11	10	8	0.92	9	8	1.5
Pyridine	100	6	0	0.79	8	0	4.2	10	0	3.8	9	0	8.8

Table 3-2
Preliminary Screening of Deep Soil Samples
MRP Properties Company, LLC - Arkansas City, Kansas

Constituent	Screening Level [a] (mg/kg)	EU 5			EU 6			EU 7			EU 8		
		Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)
Metals													
Antimony	41	4	3	0.64	4	4	0.91	5	5	1.2	--	--	--
Arsenic	0.16	22	22	**25**	22	22	**14**	20	20	**6.1**	23	22	**36**
Barium	19,000	4	4	127	4	4	139	5	5	132	--	--	--
Beryllium	200	4	4	0.75	4	4	0.99	5	5	0.78	--	--	--
Cadmium	80	4	3	0.28	4	4	0.53	5	5	0.53	--	--	--
Chromium	150,000	22	22	160	22	22	220	20	20	18	23	23	24
Lead	800	4	4	45	4	4	546	5	5	126	--	--	--
Mercury	4.3	4	2	0.030	4	1	1.8	5	0	0.040	--	--	--
Nickel	2,000	4	4	14	4	4	34	5	5	14	--	--	--
Selenium	510	4	1	0.38	4	1	0.51	5	2	0.54	--	--	--
Silver	510	4	0	0.15	4	1	4.8	5	0	0.15	--	--	--
Vanadium	520	4	4	26	4	4	29	5	5	30	--	--	--
Zinc	31,000	4	4	49	4	4	813	5	5	187	--	--	--
Cyanide	61	4	1	0.040	4	3	0.27	5	2	0.60	--	--	--
Volatile Organic Compounds													
Benzene	0.54	22	9	**3.0**	22	13	**2.0**	20	11	**5.8**	23	0	0.039
2-Butanone (MEK)	20,000	22	5	0.018	22	1	0.017	20	1	0.0066	23	2	0.045
Carbon disulfide	370	22	8	0.0090	22	3	0.042	20	1	0.012	23	1	0.00053
Chlorobenzene	140	22	0	0.15	22	0	0.13	20	0	0.034	23	0	0.026
Chloroform	0.15	22	0	**0.23** [l]	22	1	0.0050	20	0	0.051	23	0	0.040
1,2-Dibromoethane (EDB)	0.017	22	0	**0.13** [m]	22	0	**0.11** [o]	20	0	**0.028** [m]	23	0	**0.022** [p]
1,1-Dichloroethane	1.7	18	0	0.26	18	0	0.22	15	0	0.056	23	0	0.044
1,2-Dichloroethane	0.22	22	1	0.0010	22	0	0.11	20	0	0.028	23	0	0.022
1,1-Dichloroethene	110	22	0	0.26	22	0	0.22	20	0	0.056	23	0	0.044
1,4-Dioxane	1.7	22	0	**13** [m]	22	0	**11** [o]	20	0	**2.8** [m]	23	0	**2.2** [p]
Ethylbenzene	2.7	22	8	1.3	22	12	**19**	20	12	**4.5**	23	1	0.034
Methyl tert-butyl ether	22	18	0	0.25	18	0	0.22	15	0	0.056	23	0	0.043
Styrene	3,600	22	0	0.13	22	1	0.047	20	0	0.029	23	0	0.023
Tetrachloroethene (PCE)	11	22	0	0.14	22	0	0.12	20	0	0.030	23	2	0.0034
Toluene	4,500	22	3	0.16	22	8	2.5	20	13	1.8	23	0	0.034
1,1,1-Trichloroethane	3,800	22	0	0.10	22	0	0.087	20	0	0.022	23	0	0.017
Trichloroethene (TCE)	0.64	22	0	0.12	22	0	0.10	20	0	0.026	23	0	0.020
1,2,4-Trimethylbenzene	26	22	6	0.092	22	16	**130**	20	10	8.0	23	0	0.027
1,3,5-Trimethylbenzene	1,000	22	3	0.51	22	11	41	20	11	3.8	23	0	0.034
o-Xylene	300	18	3	0.46	18	14	2.7	15	7	0.77	23	1	0.032
m-Xylene & p-Xylene	250	18	3	1.1	18	11	47	15	7	3.0	23	0	0.068
Xylenes (total)	270	22	6	1.3	22	15	50	20	12	5.7	23	0	0.030

Table 3-2
Preliminary Screening of Deep Soil Samples
MRP Properties Company, LLC - Arkansas City, Kansas

Constituent	Screening Level [a] (mg/kg)	EU 5			EU 6			EU 7			EU 8		
		Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)
Semi-volatile Organic Compounds													
Acenaphthene	3,300	4	0	0.78	4	2	0.32	5	3	0.92	--	--	--
Anthracene	17,000	4	2	0.16	4	2	0.14	5	4	0.90	--	--	--
Benzo(a)anthracene	0.21	22	19	**12**	22	17	**19**	20	15	**0.76**	23	21	**11**
Benzo(a)pyrene	0.021	22	19	**8.0**	22	17	**9.2**	20	16	**0.65**	23	21	**4.4**
Benzo(b)fluoranthene	0.21	22	17	**5.1**	22	16	**5.8**	20	15	**0.34**	23	20	**3.5**
bis(2-Ethylhexyl)phthalate	12	4	4	2.4	4	4	12	5	5	**18**	--	--	--
Butyl benzyl phthalate	91	4	0	0.78	4	0	0.41	5	0	3.9	--	--	--
Chrysene	21	22	20	**24**	22	18	**34**	20	18	1.6	23	21	15
Dibenz(a,h)anthracene	0.021	22	15	**1.8**	22	13	**2.2**	20	9	**0.15**	23	19	**1.6**
1,2-Dichlorobenzene	980	4	0	0.78	4	0	0.41	5	0	3.9	--	--	--
1,4-Dichlorobenzene	1.2	4	0	0.78	4	0	0.41	5	0	**3.9** [c]	--	--	--
7,12-Dimethylbenz(a)anthracene	0.00062	4	0	**0.78** [d]	4	0	**0.41** [d]	5	0	**3.9** [d]	--	--	--
2,4-Dimethylphenol	1,200	4	0	0.78	4	0	0.41	5	0	3.9	--	--	--
2,4-Dinitrotoluene	0.55	4	0	**0.78** [n]	4	0	0.41	5	0	**3.9** [c]	--	--	--
Di-n-butyl phthalate	6,200	4	0	0.78	4	0	0.41	5	1	0.067	--	--	--
Di-n-octyl phthalate	na	4	0	0.78	4	0	0.41	5	0	3.9	--	--	--
Fluoranthene	2,200	4	3	0.28	4	2	0.081	5	4	0.47	--	--	--
Fluorene	2,200	4	1	0.10	4	3	0.73	5	4	1.6	--	--	--
Indeno(1,2,3-cd)pyrene	0.21	22	19	**1.5**	22	14	**1.2**	20	5	0.20	23	20	**1.4**
1-Methylnaphthalene	5.3	4	3	1.0	4	4	**7.2**	5	4	**12**	--	--	--
2-Methylnaphthalene	220	4	3	1.5	4	4	12	5	4	13	--	--	--
2-Methylphenol	3,100	4	0	0.78	4	0	0.41	5	0	3.9	--	--	--
4-Methylphenol	6,200	4	0	0.78	4	0	0.41	5	0	3.9	--	--	--
Naphthalene	1.8	4	3	0.66	4	3	**2.8**	5	5	**4.4**	--	--	--
Nitrobenzene	2.4	4	0	0.78	4	0	0.41	5	0	**3.9** [c]	--	--	--
Phenanthrene	na	4	3	2.2	4	4	2.2	5	4	7.6	--	--	--
Phenol	18,000	4	0	0.78	4	0	0.41	5	0	3.9	--	--	--
Pyrene	1,700	4	3	1.6	4	3	0.48	5	4	3.9	--	--	--
Pyridine	100	4	0	0.78	4	0	0.41	5	0	3.9	--	--	--

Table 3-2
Preliminary Screening of Deep Soil Samples
MRP Properties Company, LLC - Arkansas City, Kansas

Constituent	Screening Level [a] (mg/kg)	EU 9			EU 10			EU 11			EU JSA		
		Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)
Metals													
Antimony	41	3	0	0.32	3	0	0.31	5	1	0.98	12	6	1
Arsenic	0.16	22	21	**9.1**	23	23	**7.8**	17	17	**57**	26	26	**26**
Barium	19,000	3	3	122	3	3	80	5	5	123	12	12	195
Beryllium	200	3	3	0.68	3	3	0.47	5	5	0.63	12	12	1
Cadmium	80	3	3	0.48	3	3	0.65	5	5	1.2	12	11	1.3
Chromium	150,000	22	22	87	23	23	1,200	17	17	120	26	26	42
Lead	800	3	3	8.9	3	3	82	5	5	106	12	12	46
Mercury	4.3	3	0	0.040	3	1	0.54	5	3	1.7	12	8	1.1
Nickel	2,000	3	3	14	3	3	12	5	5	17	12	12	27
Selenium	510	3	0	0.39	3	0	0.38	2	0	0.38	12	2	0.75
Silver	510	3	0	0.14	3	0	0.14	5	0	0.15	12	0	0.20
Vanadium	520	3	3	24	3	3	24	5	5	25	12	12	43
Zinc	31,000	3	3	44	3	3	87	5	5	239	12	12	174
Cyanide	61	3	0	0.18	3	1	0.23	5	1	2.4	12	0	0.24
Volatile Organic Compounds													
Benzene	0.54	22	11	**0.64**	23	14	**2.1**	17	11	**12**	26	3	**5.1**
2-Butanone (MEK)	20,000	22	9	0.16	23	6	0.078	17	3	0.32	26	0	0.46
Carbon disulfide	370	22	5	0.010	23	6	0.0060	17	4	0.39	26	1	0.0020
Chlorobenzene	140	22	0	0.031	23	0	0.035	17	0	0.54	26	0	0.46
Chloroform	0.15	22	0	0.047	23	1	**0.24**	17	2	0.15	26	1	**0.72**
1,2-Dibromoethane (EDB)	0.017	22	0	**0.026** [q]	23	0	**0.029** [r]	17	0	**0.54** [s]	26	0	**0.46** [c]
1,1-Dichloroethane	1.7	19	0	0.052	20	0	0.058	12	1	0.00035	14	0	0.00036
1,2-Dichloroethane	0.22	22	0	0.026	23	0	0.029	17	0	**0.54** [t]	26	0	**0.46** [c]
1,1-Dichloroethene	110	22	1	0.0010	23	0	0.058	17	0	0.54	26	0	0.46
1,4-Dioxane	1.7	22	0	**2.6** [q]	23	0	**2.9** [r]	17	0	**54** [s]	26	0	**46** [c]
Ethylbenzene	2.7	22	11	**4.2**	23	13	**3.2**	17	12	1.9	26	2	**12**
Methyl tert-butyl ether	22	19	0	0.051	20	0	0.058	12	0	0.054	14	0	0.00058
Styrene	3,600	22	0	0.027	23	0	0.030	17	0	0.54	26	0	0.46
Tetrachloroethene (PCE)	11	22	1	0.0010	23	1	0.0012	17	0	0.54	26	0	0.46
Toluene	4,500	22	7	4.8	23	10	0.30	17	8	0.53	26	2	0.42
1,1,1-Trichloroethane	3,800	22	0	0.021	23	0	0.023	17	0	0.54	26	0	0.46
Trichloroethene (TCE)	0.64	22	0	0.024	23	3	0.016	17	0	0.54	26	0	0.46
1,2,4-Trimethylbenzene	26	22	13	**73**	23	8	0.46	17	11	14	26	2	6.2
1,3,5-Trimethylbenzene	1,000	22	11	16	23	11	1.8	17	9	7.6	26	2	4.2
o-Xylene	300	19	8	8	20	11	0.18	12	9	0.89	14	0	0.0010
m-Xylene & p-Xylene	250	19	14	14	20	11	2.1	12	9	4.2	14	0	0.0018
Xylenes (total)	270	22	14	22	23	12	2.3	17	12	5.0	26	2	0.32

Table 3-2
Preliminary Screening of Deep Soil Samples
MRP Properties Company, LLC - Arkansas City, Kansas

Constituent	Screening Level [a] (mg/kg)	EU 9			EU 10			EU 11			EU JSA		
		Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)
Semi-volatile Organic Compounds													
Acenaphthene	3,300	3	0	0.39	2	0	0.38	5	1	1.4	12	2	0.043
Anthracene	17,000	3	0	0.39	2	2	0.38	5	4	1.7	12	5	2.3
Benzo(a)anthracene	0.21	22	17	**4.4**	22	15	**2.7**	17	16	**28**	26	18	**77**
Benzo(a)pyrene	0.021	22	19	**3.8**	22	15	**3.3**	17	14	**15**	26	17	**82**
Benzo(b)fluoranthene	0.21	22	15	**4.4**	22	17	**2.0**	17	14	**14**	26	15	**130**
bis(2-Ethylhexyl)phthalate	12	3	2	2.0	2	2	3.6	5	3	12	12	7	**14**
Butyl benzyl phthalate	91	3	0	0.39	2	0	0.38	5	0	1.9	12	0	7.4
Chrysene	21	22	20	7.6	22	20	7	17	17	**63**	26	20	**95**
Dibenz(a,h)anthracene	0.021	22	12	**1.1**	22	12	**1.3**	17	11	**5.2**	26	15	**15**
1,2-Dichlorobenzene	980	3	0	0.39	2	0	0.38	5	0	1.9	12	0	7.4
1,4-Dichlorobenzene	1.2	3	0	0.39	2	0	0.38	5	0	**1.9** [c]	12	0	**7.4** [j]
7,12-Dimethylbenz(a)anthracene	0.00062	3	0	**0.39** [d]	2	0	**0.38** [d]	5	0	**1.9** [d]	12	0	**7.4** [d]
2,4-Dimethylphenol	1,200	3	0	0.39	2	0	0.38	5	0	1.9	12	0	7.4
2,4-Dinitrotoluene	0.55	3	0	0.39	2	0	0.38	5	0	**1.9** [c]	12	0	**7.4** [j]
Di-n-butyl phthalate	6,200	3	1	0.024	2	1	0.043	5	2	0.029	12	3	0.023
Di-n-octyl phthalate	na	3	0	0.39	2	1	0.20	5	0	1.9	12	1	0.23
Fluoranthene	2,200	3	0	0.39	2	2	0.11	5	5	0.53	12	5	6.4
Fluorene	2,200	3	0	0.39	2	0	0.38	5	4	2.1	12	3	0.50
Indeno(1,2,3-cd)pyrene	0.21	22	12	**1.5**	22	15	**1.1**	17	12	**4.5**	26	16	**42**
1-Methylnaphthalene	5.3	3	0	0.39	2	1	0.059	5	5	**17**	12	6	0.8
2-Methylnaphthalene	220	3	0	0.39	2	2	0.082	5	5	24	12	6	3.4
2-Methylphenol	3,100	3	0	0.39	2	0	0.38	5	0	1.9	12	0	7.4
4-Methylphenol	6,200	3	0	0.39	2	0	0.38	5	0	1.9	12	0	7.4
Naphthalene	1.8	3	1	0.022	2	2	0.059	5	5	**8.5**	12	6	1.6
Nitrobenzene	2.4	3	0	0.39	2	0	0.38	5	0	1.9	12	0	**7.4** [c]
Phenanthrene	na	3	2	0.072	2	2	0.63	5	5	7.7	12	8	35
Phenol	18,000	3	0	0.39	2	0	0.38	5	1	0.052	12	0	7.4
Pyrene	1,700	3	2	0.038	2	2	0.55	5	5	3.2	12	7	23
Pyridine	100	3	0	0.39	2	0	0.38	5	0	1.9	12	0	7.4

Table 3-2
Preliminary Screening of Deep Soil Samples
MRP Properties Company, LLC - Arkansas City, Kansas

Constituent	Screening Level [a] (mg/kg)	EU CDL			Deep Soils Data Summary for 13 EUs				Deep Soils Risk Screen [w]	
		Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Site Maximum Value (mg/kg)	Site Number of Samples	Site Number of Detects	Percent Detect	Screening Cancer Risk Estimate	Screening Noncancer Hazard Estimate
Metals										
Antimony	41	--	--	--	6.9	70	38	54.3%		0.017
Arsenic	0.16	9	9	**12**	57	240	238	99.2%	**3.6E-05**	
Barium	19,000	--	--	--	281	70	70	100.0%		0.0015
Beryllium	200	--	--	--	1.2	70	69	98.6%		0.00060
Cadmium	80	--	--	--	1.8	70	56	80.0%		0.0023
Chromium	150,000	9	9	410	1,200	240	240	100.0%		0.00080
Lead	800	9	9	**1,400**	1,400	79	79	100.0%		**1.8**
Mercury	4.3	--	--	--	1.8	68	27	39.7%		0.042
Nickel	2,000	--	--	--	38	70	70	100.0%		0.0019
Selenium	510	--	--	--	2.0	63	19	30.2%		0.00039
Silver	510	--	--	--	4.8	70	4	5.7%		0.00094
Vanadium	520	--	--	--	56	70	70	100.0%		0.011
Zinc	31,000	--	--	--	875	70	70	100.0%		0.0028
Cyanide	61	--	--	--	2.4	70	11	15.7%		0.0039
Volatile Organic Compounds										
Benzene	0.54	9	6	**0.92**	12	239	113	47.3%	**2.2E-06**	
2-Butanone (MEK)	20,000	9	2	0.0096	0.55	239	37	15.5%		0.0000028
Carbon disulfide	370	9	1	0.00069	4.5	239	49	20.5%		0.0012
Chlorobenzene	140	9	0	0.27	1.0	239	0	0.0%		0.00071
Chloroform	0.15	9	0	**0.41** [u]	2.0	239	9	3.8%	**1.3E-06**	
1,2-Dibromoethane (EDB)	0.017	9	0	**0.22** [v]	1.0	239	0	0.0%	**5.9E-06**	
1,1-Dichloroethane	1.7	9	0	0.45	0.45	170	1	0.6%	2.6E-08	
1,2-Dichloroethane	0.22	9	0	0.22	1.0	239	1	0.4%	**4.5E-07**	
1,1-Dichloroethene	110	9	1	0.00065	1.0	239	2	0.8%		0.00091
1,4-Dioxane	1.7	9	0	**22** [v]	100	239	0	0.0%	**5.9E-06**	
Ethylbenzene	2.7	9	6	**4.9**	26	239	96	40.2%	**9.6E-07**	
Methyl tert-butyl ether	22	9	0	0.44	0.44	170	0	0.0%	2.0E-09	
Styrene	3,600	9	0	0.23	1.0	239	1	0.4%		0.000028
Tetrachloroethene (PCE)	11	9	1	0.0026	1.0	239	5	2.1%	9.1E-09	
Toluene	4,500	9	3	0.087	4.8	239	80	33.5%		0.00011
1,1,1-Trichloroethane	3,800	9	0	0.18	1.0	239	0	0.0%		0.000026
Trichloroethene (TCE)	0.64	9	0	0.20	1.0	239	3	1.3%	**1.6E-07**	
1,2,4-Trimethylbenzene	26	9	7	**78**	130	239	98	41.0%		**0.50**
1,3,5-Trimethylbenzene	1,000	9	5	7.7	41	239	84	35.1%		0.0041
o-Xylene	300	9	7	0.73	7.7	170	69	40.6%		0.0026
m-Xylene & p-Xylene	250	9	6	16	47	170	69	40.6%		0.019
Xylenes (total)	270	9	7	17	50	239	107	44.8%		0.019

Table 3-2
Preliminary Screening of Deep Soil Samples
MRP Properties Company, LLC - Arkansas City, Kansas

Constituent	Screening Level [a] (mg/kg)	EU CDL			Deep Soils Data Summary for 13 EUs				Deep Soils Risk Screen [w]	
		Number of Samples	Number of Detects	Maximum Value [b] (mg/kg)	Site Maximum Value (mg/kg)	Site Number of Samples	Site Number of Detects	Percent Detect	Screening Cancer Risk Estimate	Screening Noncancer Hazard Estimate
Semi-volatile Organic Compounds										
Acenaphthene	3,300	--	--	--	1.4	68	16	23.5%		0.000042
Anthracene	17,000	--	--	--	2.3	68	35	51.5%		0.000014
Benzo(a)anthracene	0.21	9	9	**12**	77	238	180	75.6%	**3.7E-05**	
Benzo(a)pyrene	0.021	9	9	**5.3**	82	238	182	76.5%	**3.9E-04**	
Benzo(b)fluoranthene	0.21	9	9	**3.7**	130	238	169	71.0%	**6.2E-05**	
bis(2-Ethylhexyl)phthalate	12	--	--	--	18	68	54	79.4%	**1.5E-07**	
Butyl benzyl phthalate	91	--	--	--	8.8	68	0	0.0%	9.7E-09	
Chrysene	21	9	9	**27**	95	238	207	87.0%	**4.5E-07**	
Dibenz(a,h)anthracene	0.021	9	7	**1.2**	15	238	133	55.9%	**7.1E-05**	
1,2-Dichlorobenzene	980	--	--	--	8.8	68	0	0.0%		0.00090
1,4-Dichlorobenzene	1.2	--	--	--	8.8	68	0	0.0%	**7.3E-07**	
7,12-Dimethylbenz(a)anthracene	0.00062	--	--	--	8.8	68	0	0.0%	**1.4E-03**	
2,4-Dimethylphenol	1,200	--	--	--	7.4	68	1	1.5%		0.00062
2,4-Dinitrotoluene	0.55	--	--	--	8.8	68	0	0.0%	**1.6E-06**	
Di-n-butyl phthalate	6,200	--	--	--	0.78	68	17	25.0%		0.000013
Di-n-octyl phthalate	na	--	--	--	8.8	68	2	2.9%		na
Fluoranthene	2,200	--	--	--	6.4	68	32	47.1%		0.00029
Fluorene	2,200	--	--	--	4.8	68	34	50.0%		0.00022
Indeno(1,2,3-cd)pyrene	0.21	9	8	**1.1**	42	238	147	61.8%	**2.0E-05**	
1-Methylnaphthalene	5.3	--	--	--	42	68	47	69.1%	**7.9E-07**	
2-Methylnaphthalene	220	--	--	--	43	68	48	70.6%		0.020
2-Methylphenol	3,100	--	--	--	8.8	68	0	0.0%		0.00028
4-Methylphenol	6,200	--	--	--	7.4	68	2	2.9%		0.00012
Naphthalene	1.8	--	--	--	27	68	47	69.1%	**1.5E-06**	
Nitrobenzene	2.4	--	--	--	8.8	68	0	0.0%	**3.7E-07**	
Phenanthrene	na	--	--	--	35	68	53	77.9%		na
Phenol	18,000	--	--	--	8.8	68	4	5.9%		0.000049
Pyrene	1,700	--	--	--	23	68	52	76.5%		0.0014
Pyridine	100	--	--	--	8.8	68	0	0.0%		0.0088

Table 3-2
Preliminary Screening of Deep Soil Samples
MRP Properties Company, LLC - Arkansas City, Kansas

Notes:

Bolding of a chemical name indicates that the screening level was exceeded by one or more detected concentrations in one or more exposure units; **bolding** of a maximum value indicates that the screening level was exceeded by that maximum value. **Bolding** of a screening level risk or hazard indicates exceedance of a cancer risk of $1x10^{-7}$ or HQ of 0.1.

bold Italics of a chemical name indicates that for one or more exposure units, the analyte was not detected, and either sample RL exceeded the screening level in one or more samples and MDLs were unavailable for those samples, or both the sample RL and the MDL exceeded the screening level.

-- - analyte not analyzed in the indicated year.
mg/kg - milligrams per kilogram
na - not available; no EPA Regional Screening Level is available for this chemical

[a] Screening value is equal to the US EPA Industrial Soil Regional Screening Level (RSL) for carcinogenic chemicals, or equal to 1/10 [th] of Industrial Soil RSL for noncarcinogenic chemicals to account for potential cumulative effects.
[b] Maximum value is the greatest detected value, or, if the analyte was not detected, the maximum sample reporting limit (RL) or analytical method detection limit (MDL).
[c] The analyte was non detect and the sample RL exceeded the screening level in one sample; MDLs are unavailable for this sample.
[d] The analyte was non detect and the sample RL exceeded the screening level in all samples; MDLs are unavailable for these samples
[e] The analyte was non detect and the sample RL exceeded the screening level in four samples; MDLs are unavailable for one of these samples.
[f] The analyte was non detect and the sample RL exceeded the screening level in four samples; MDLs are available for three of these samples; these MDLs also exceeded screening level.
[g] The analyte was non detect and the sample RLs exceeded the screening level in three samples; MDLs are unavailable for these samples.
[h] The analyte was non detect and the sample RL exceeded the screening level in seven samples; MDLs are available for two of these samples; these MDLs also exceeded screening level.
[i] The analyte was non detect and the sample RL exceeded the screening level in seven samples; MDLs are unavailable for five of these samples.
[j] The analyte was non detect and the sample RLs exceeded the screening level in two samples; MDLs are unavailable for these samples.
[k] The analyte was non detect and the s - exceedance due to RSL footnote
[l] The analyte was non detect and the s - exceedance due to MDL footnote
[m] The analyte was non detect and the sample RL and analytical MDL exceeded the screening level in seven samples.
[n] The analyte was non detect and the sample RL exceeded the screening level in two samples; MDLs are unavailable for these samples.
[o] The analyte was non detect and the sample RL and analytical MDL exceeded the screening level in fourteen samples.
[p] The analyte was non detect and the sample RL and analytical MDL exceeded the screening level in one sample.
[q] The analyte was non detect and the sample RL and analytical MDL exceeded the screening level in six samples.
[r] The analyte was non detect and the sample RL and analytical MDL exceeded the screening level in ten samples.
[s] The analyte was non detect and the sample RL exceeded the screening level in seven samples; MDLs are available for five of these samples and these MDLs also exceeded screening level.
[t] The analyte was non detect and the sample RL exceeded the screening level in seven samples; MDLs are unavailable for two of these samples.
[u] The analyte was non detect and the sample RL exceeded the screening level in five samples. MDLs are available for all of these samples; the MDL exceeded the screening level in one sample.
[v] The analyte was non detect and the sample RL and analytical MDL exceeded the screening level in five samples.
[w] The screening-level cancer risk estimate or noncancer HQ estimate is bolded if it exceeds a cancer risk of 1x10-6 or HQ of 0.1, respectively, to account for potential cumulative effects.

Table 3-3
Data Gap Summary and Proposed Phase I and Phase II Data Gap Soil Investigation Sampling Plan
MRP Properties Company, LLC, Arkansas City, Kansas

Depth	EU 1		EU 2		EU 3		EU 4		EU 5		EU 6		EU 7		EU 8		EU 9		EU 10		EU 11		EU JSA		EU CDL	
	1999	2010	1999	2010	1999	2010	1999	2010	1999	2010	1999	2010	1999	2010	1999	2010	1999	2010	1999	2010	1999	2010	1999	2010	1999	2010
Current Sample Counts [a]																										
Shallow (0 - 2 ft bgs)																										
metals	6	7	7	7	9	5	8	6	4	9	4	9	4	9	0	13	3	10	3	10	5	8	11	15	0	9
VOCs	7	6	6	8	4	10	5	8	9	4	9	4	8	5	0	13	3	10	3	10	8	5	14	12	0	9
SVOCs	6	7	8	6	10	4	8	5	4	9	4	9	5	8	0	13	3	10	3	10	5	8	11	15	0	9
Medium (2 - 4 ft bgs)																										
metals	6	7	7	7	10	5	7	7	4	9	4	9	5	8	0	13	3	10	3	10	8	5	14	12	0	9
VOCs	7	6	6	8	4	10	5	9	9	4	9	4	8	5	0	13	3	10	2	10	5	8	12	14	0	9
SVOCs	6	7	8	6	10	4	9	5	4	18	4	9	5	8	0	13	3	10	3	10	5	8	12	14	0	9
Deep (4 - 10 ft bgs)																										
metals	0	0	0	0	0	0	0	0	0	9	0	9	0	7	0	10	0	9	0	10	0	4	0	0	0	0
VOCs	0	0	0	0	0	0	0	0	0	9	0	9	0	7	0	10	0	9	0	10	0	4	0	0	0	0
SVOCs	0	0	0	0	0	0	0	0	0	9	0	9	0	7	0	10	0	9	0	10	0	4	0	0	0	0
Current Sample Coverage Summary																										
	All COPCs have sufficient coverage for ProUCL in shallow and medium soil; no deep soil samples.								All COPCs have sufficient coverage for ProUCL in shallow, medium, and deep soil.				All COPCs in current dataset have sufficient coverage for ProUCL in shallow, medium, and deep soil, however, analyte list for all depths is limited.		All COPCs have sufficient coverage for ProUCL in shallow, medium, and deep soil (Based on the assumption that at least 4 (i.e. EU 11) samples in deep soil is enough samples as long as there are additional results for medium depth soil).						All COPCs have sufficient coverage for ProUCL in shallow and medium soil; no deep samples.		All COPCs have sufficient coverage for ProUCL in shallow and medium soil; no deep soil samples. Limited analyte list at all depths.	
Phase I Data Gap Soil Investigation (Proposed)																										
Shallow (0 - 2 ft bgs)																										
8270 SIM [b]	2		2		2		2		2		2		2		2		2		2		2		2		2	
$Cr\ 6^{+}$ [c]	-		-		1		1		2		2		-		2		2		5		3		1		10	
Medium (2 - 4 ft bgs)																										
8270 SIM [b]	1		1		1		1		1		1		1		1		1		1		1		1		1	
$Cr\ 6^{+}$ [c]	-		-		1		1		2		2		-		2		2		5		3		1		10	
Deep (4 - 10 ft bgs)																										
8270 SIM [b]	1		1		1		1		1		1		1		1		1		1		1		1		1	
$Cr\ 6^{+}$ [c]	-		-		1		1		2		2		-		2		2		5		3		1		10	

Depth	Background As [d]
Shallow (0 - 2 ft bgs)	8
Medium (2 - 4 ft bgs)	8
Deep (4 - 10 ft bgs)	8

Phase II Data Gap Soil Investigation (Proposed) [e]														
Shallow (0 - 2 ft bgs)														
metals [f]	-	-	-	-	-	-	-	8	-	-	-	-	8	
VOCs	-	-	-	-	-	-	-	-	-	-	-	-	-	
SVOCs	-	-	-	-	-	-	-	8	-	-	-	-	8	
Medium (2 - 4 ft bgs)														
metals [f]	-	-	-	-	-	-	-	4	-	-	-	-	4	
VOCs	-	-	-	-	-	-	-	-	-	-	-	-	-	
SVOCs	-	-	-	-	-	-	-	4	-	-	-	-	4	
Deep (4 - 10 ft bgs)														
metals [f]	4	4	4	4	-	-	-	4	-	-	-	4	4	
VOCs	4	4	4	4	-	-	-	-	-	-	-	4	4	
SVOCs	4	4	4	4	-	-	-	4	-	-	-	4	4	

Notes:
bgs - below ground surface
CDL - Construction Debris Landfill
COPC - constituent of potential concern
EU - exposure unit
ft - feet
JSA - Junk Storage Area
SIM - selective ion monitoring
SVOC - semi-volatile organic compounds
VOC - volatile organic compounds

[a] The current sample count identifies number of samples collected during the 1999 Phase II RFI (Earth Tech, 2000) and the 2010 EUSSI (MWH, 2012). The 1999 Phase II RFI data includes the full list of metals, VOCs, and SVOCs. The 2010 EUSSI data consists of As, Cr, (plus Pb at the CDL) VOCs, and 6 PAHs. See Tables 3-1 and 3-2 for greater detail.

[b] Two surface and two subsurface soil samples will be collected from soil at each exposure unit and analyzed by USEPA Method 8270C SIM to confirm the presence or absence of 7,12-dimethylbenz(a)anthracene.

[c] Hexavalent chromium ($Cr\ 6^{+}$) will be sampled for in surface and subsurface soil at locations where total chromium was detected above 37 milligrams per kilogram (mg/kg) which is the mean background concentration for chromium in soils within the coterminous United States (Shacklette and Boerngen, 1984).

[d] Background soil samples for arsenic (As) will be collected during Phase I from the shallow, medium, and deep intervals at eight locations (24 total samples) outside the refinery south of the CDL.

[e] The Phase II sampling may be modified depending on the Phase I sampling results.

[f] EU 1 - 4 and JSA metals will be As, Ha, and Pb. EU-8 and CDL metals will be the full (Phase II RFI 1999) list.

Table 4-1
Human Health COPC Screening Criteria for Soil
MRP Properties Company, LLC - Arkansas City, Kansas

Analyte	USEPA RSL [a] (mg/kg)	COPC Screening Level [b] (mg/kg)	Cancer/ Noncancer
Metals			
Antimony	410	41	nc
Arsenic	1.6	0.16	c
Barium	190,000	19,000	nc
Beryllium	2,000	200	nc
Cadmium	800	80	nc
Chromium	1,500,000	150,000	nc
Chromium, Hexavalent	5.6	0.56	c
Lead	800	800	nc
Mercury	43	4.3	nc
Nickel	20,000	2,000	nc
Selenium	5,100	510	nc
Silver	5,100	510	nc
Vanadium	5,200	520	nc
Zinc	310,000	31,000	nc
Cyanide	610	61	nc
Volatile Organic Compounds			
Benzene	5.4	0.54	c
2-Butanone (MEK)	200,000	20,000	nc
Carbon disulfide	3,700	370	nc
Chlorobenzene	1,400	140	nc
Chloroform	1.5	0.15	c
1,2-Dibromoethane (EDB)	0.17	0.017	c
1,4-Dichlorobenzene	12	1.2	c
1,1-Dichloroethane	17	1.7	c
1,2-Dichloroethane	2.2	0.22	c
1,1-Dichloroethene	1,100	110	nc
Ethylbenzene	27	2.7	c
Methyl tert-butyl ether	220	22	c
Naphthalene	18	1.8	c
Styrene	36,000	3,600	nc
Tetrachloroethene (PCE)	110	11	c
Toluene	45,000	4,500	nc
1,1,1-Trichloroethane	38,000	3,800	nc
Trichloroethene (TCE)	6.4	0.64	c
1,2,4-Trimethylbenzene	260	26	nc
1,3,5-Trimethylbenzene	10,000	1,000	nc
o-Xylene	3,000	300	nc
m-Xylene & p-Xylene	2,500	250	nc
Xylenes (total)	2,700	270	nc

Table 4-1
Human Health COPC Screening Criteria for Soil
MRP Properties Company, LLC - Arkansas City, Kansas

Analyte	USEPA RSL [a] (mg/kg)	COPC Screening Level [b] (mg/kg)	Cancer/ Noncancer
Semi-volatile Organic Compounds			
Acenaphthene	33,000	3,300	nc
Anthracene	170,000	17,000	nc
Benzo(a)anthracene	2.1	0.21	c
Benzo(a)pyrene	0.21	0.021	c
Benzo(b)fluoranthene	2.1	0.21	c
bis(2-Ethylhexyl)phthalate	120	12	c
Butyl benzyl phthalate	910	91	c
Chrysene	210	21	c
Dibenz(a,h)anthracene	0.21	0.021	c
1,2-Dichlorobenzene	9,800	980	nc
1,4-Dioxane	17	1.7	c
7,12-Dimethylbenz(a)anthracene	0.0062	0.00062	c
2,4-Dimethylphenol	12,000	1,200	nc
2,4-Dinitrotoluene	5.5	0.55	c
Di-n-butyl phthalate	62,000	6,200	nc
Di-n-octyl phthalate	na	na	--
Fluoranthene	22,000	2,200	nc
Fluorene	22,000	2,200	nc
Indeno(1,2,3-cd)pyrene	2.1	0.21	c
1-Methylnaphthalene	53	5.3	c
2-Methylnaphthalene	2,200	220	nc
2-Methylphenol	31,000	3,100	nc
4-Methylphenol	62,000	6,200	nc
Nitrobenzene	24	2.4	c
Phenanthrene	na	na	--
Phenol	180,000	18,000	nc
Pyrene	17,000	1,700	nc
Pyridine	1,000	100	nc

Notes:

-- not applicable
c - cancer
COPC - constituent of potential concern
mg/kg - milligrams per kilogram
na - not available
nc - noncancer
USEPA - United States Environmental Protection Agency

[a] Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites - Industrial Soil (USEPA, 2012a).

[b] Screening levels are based on cancer risk of 1×10^{-7} or a hazard index of 0.1 to account for potential cumulative effects. The screening level for lead is not divided by 10 because lead is not included in the cumulative hazard estimate.

Table 4-2
Exposure Assumptions to be Used in the Human Health Risk Assessment
MRP Properties Company, LLC - Arkansas City, Kansas

Exposure Parameter	Units	Future Commercial / Industrial Workers		Future Utility / Construction Workers	
General					
BW = body weight	kg	70	c	70	a
ATc = averaging time for carcinogens	days	25,550	c	25,550	a
ATn = averaging time for non-carcinogens	days	9,125	c	365	b
EF = exposure frequency	days/year	225	c	50	c
ED = exposure duration	years	25	c	1	b
Direct Contact with Soil					
IR = ingestion rate	mg/day	100	c	330	a
SA = surface area	cm^2	3,300	c	3,300	a
AF = soil-to-dermal adherence factor	mg/cm^2	0.2	c	0.3	a
ABS = absorption fraction through skin for chemicals in soil	unitless	CS		CS	
VF = volatilization factor	m^3/kg	CS		CS	
PEF = particulate emission factor	m^3/kg	6.85E+08	a	6.85E+08	a
Chemical and Exposure Parameters for the Inhalation Pathway					
D_A = apparent diffusivity	cm^2/s	CS		CS	
D_i = diffusivity in air	cm^2/s	CS		CS	
D_w = diffusivity in water	cm^2/s	CS		CS	
ET = exposure time	hrs/day	8		8	
H' = dimensionless Henry's law constant	unitless	CS		CS	
K_d = soil-water partition coefficient (K_{oc} x f_{oc})	L/kg	CS		CS	
Q/C_{vf} = inverse of the mean conc. at the center of a 5 acre source	g/m^2-s per kg/m^3	SS		SS	
T = exposure interval(s)	seconds	SS		SS	

Notes

°C - degrees Celsius
cm - centimeter
cm^2 - square centimeters
cm^2/s - square centimeters per second
CS - chemical-specific
f_{oc} - fraction organic carbon in soil
g/m^2-s per kg/m^3 - grams per square meter per second per kilograms per cubic meter
hrs - hours
kg - kilogram
K_{oc} - soil organic carbon-water partitioning coefficient
L/kg - liters per kilogram
L_{air} - liters air
L_{pore} - liters pore
L_{soil} - liters soil
L_{water} - liters water
m^3/Kg - cubic meters per kilogram
mg/cm^2 - milligrams per square centimeter
mg/day - milligrams per day
NA- not applicable
SS - site-specific
USEPA - U.S. Environmental Protection Agency

[a] USEPA (2002) Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-25. December.

[b] A construction or utility worker is assumed to be on Site 50 days per year, for one year.

[c] Exposure parameters for the commercial or industrial receptor are equal to the outdoor industrial worker parameters in USEPA (2002).

Table 4-3
Toxicity Values to be Used in the Human Health Risk Assessment
MRP Properties Company, LLC - Arkansas City, Kansas

	Cancer Slope Factor $(mg/kg\text{-}d)^{-1}$		URF $(\mu g/m^3)^{-1}$	Chronic Reference Dose (mg/kg-d)		RfC (mg/m^3)	ABS_{GI} [a] (%)
	Oral	Dermal[b]	Inhalation	Oral	Dermal[b]	Inhalation	
Metals							
Arsenic	1.5E+00 I	1.5E+00 R	4.3E-03 I	3.0E-04 I	3.0E-04 R	1.5E-05 C	95%
Lead	na	na	na	na	na	na	na
Volatile Organic Compounds							
Benzene	5.5E-02 I	5.5E-02 R	7.8E-06 I	4.0E-03 I	4.0E-03 R	3.0E-02 I	100%
Chloroform	1.0E-02 I	1.0E-02 R	2.3E-05 I	1.0E-02 I	1.0E-02 R	9.8E-02 A	100%
1,2-Dibromoethane (EDB)	2.0E+00 I	2.0E+00 R	6.0E-04 I	9.0E-03 I	9.0E-03 R	9.0E-03 I	100%
1,2,4-Trimethylbenzene	na	na	na	na	na	7.0E-03 P	100%
1,4-Dioxane	1.0E-01 I	1.0E-01 R	7.7E-06 C	3.0E-02 I	3.0E-02 R	3.0E+00 C	100%
Semi-volatile Organic Compounds							
Benzo(a)anthracene	7.3E-01 E	7.3E-01 R	1.1E-04 C	na	na	na	89%
Benzo(a)pyrene	7.3E+00 I	7.3E+00 R	1.1E-03 C	na	na	na	89%
Benzo(b)fluoranthene	7.3E-01 E	7.3E-01 R	1.1E-04 C	na	na	na	89%
Dibenz(a,h)anthracene	7.3E+00 E	7.3E+00 R	1.2E-03 C	na	na	na	89%
7,12-Dimethylbenz(a)anthracene	2.5E+02 C	2.5E+02 R	7.1E-02 C	na	na	na	100%
2,4-Dinitrotoluene	3.1E-01 C	3.1E-01 R	8.9E-05 C	2.0E-03 I	2.0E-03 R	na	100%
1,4-Dichlorobenzene	5.4E-03 C	5.4E-03 R	1.1E-05 C	7.0E-02 A	7.0E-02 R	8.0E-01 I	100%
Indeno(1,2,3-cd)pyrene	7.3E-01 E	7.3E-01 R	1.1E-04 C	na	na	na	89%
Naphthalene	na	na	3.4E-05 C	2.0E-02 I	2.0E-02 R	3.0E-03 I	89%

Sources:

A Agency for Toxic Substances and Disease Registry (ATSDR) minimal risk levels as cited in USEPA Regional Screening Level (RSL) Tabe (USEPA, 2012a)

C Cal-EPA Toxicity Values as cited in USEPA RSLs (USEPA, 2012a)

E Environmental Criteria and Assessment Offic as cited in USEPA RSLs (USEPA, 2012a)

I Integrated Risk Information System (IRIS) Database (USEPA, 2012b)

P Provisional Peer Reviewed Toxicity Values (PPRTVs) as cited in USEPA RSL Table (USEPA, 2012a)

R Route Extrapolation.

Notes:

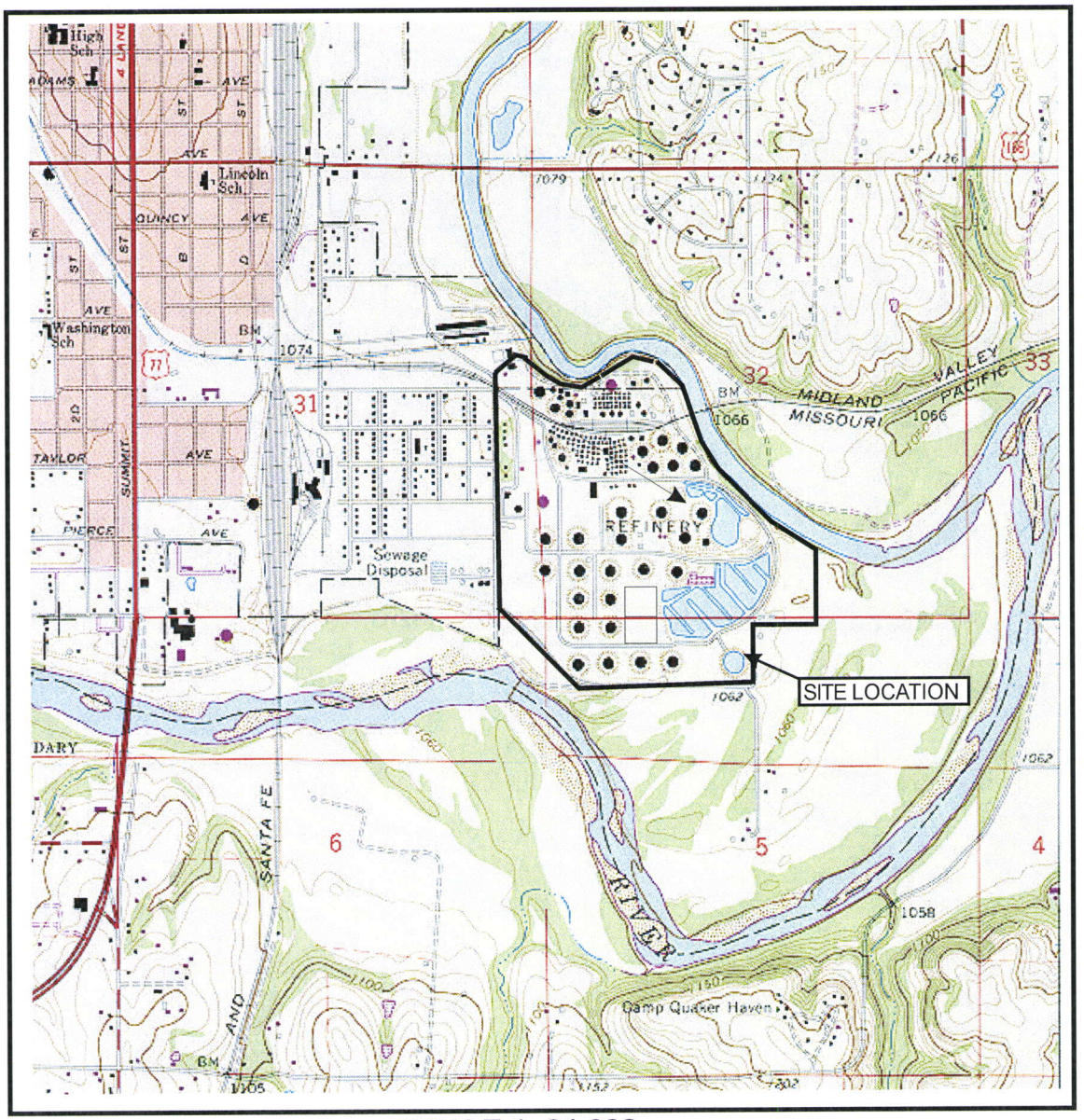
ABS_{GI} - oral absorption efficiency
CSF - cancer slope factor
mg/kg-d - milligrams per kilogram per day
mg/m^3 - milligrams per cubic meter
na - not available
RfC - reference concentration
RfD - reference dose
USEPA - U. S. Environmental Protection Agency
URF - unit risk factor
$\mu g/m^3$ - micrograms per cubic meter
% - percent

[a] Values are from USEPA RAGS Part E. Where no specific ABS_{GI} is available, the ABS_{GI} is assumed to be 100% (USEPA 2004).

[b] Oral-to-dermal extrapolations were performed according to USEPA (2004). When ABSGI is less than 50 percent: Dermal RfD = Oral RfD x ABSGI and Dermal CSF = Oral SF/ABSGI. When ABSGI is greater than 50 percent, the dermal CSF and/or RfD is assumed to be equal to the oral CSF and/or RfD (USEPA, 2006).

FIGURES

R 4 E



T 34 S

T 35 S

SCALE 1: 24,000

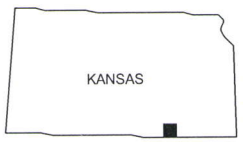
1 0 1/2 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

0 .5 0 1 KILOMETER

CONTOUR INTERVAL: 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

ARKANSAS CITY, KANS.
N3700-W9700/7.5
1965
PHOTOREVISED 1979
AMS 6558 II SE-SERIES V878



QUADRANGLE LOCATION

MWH

FIGURE: 1-1

SITE LOCATION MAP

PROJECT: MRP PROPERTIES COMPANY, LLC
ARKANSAS CITY, KANSAS

1010417.0401	DESIGNED BY:	JFM	APPROVED BY:	
Figure 1-1_2011.PDF	DRAWN BY:	RPH	DATE: 4/4/11	REV:

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EXPLANATION

APPROXIMATE PROPERTY BOUNDARY

INVESTIGATION AREAS

- PROCESS AREA BOUNDARY
- JUNK STORAGE AREA BOUNDARY
- CDL BOUNDARY

SITE FEATURES (APPROXIMATE EXTENTS)

- ASPHALT TANK
- ASPHALT UNIT
- CLOSED SURFACE IMPOUNDMENTS (CSI)
- LAND TREATMENT UNIT (LTU)
- LIFT STATION
- MAIN PROCESS AREA
- No. 3B POND
- OFFICE
- OXIDATION PONDS

N
W E
S

SCALE IN FEET
0 400 800

AERIAL PHOTO:
MARCH 12, 2005

REVISION	DATE	DESIGN BY	DRAWN BY	REVIEWED BY
Revision 2	4/22/2011	JFM	RPH	JFM

TITLE:

SITE PLAN

PROJECT:

MRP PROPERTIES COMPANY, LLC
ARKANSAS CITY, KANSAS

MWH

Figure No.:
1-2

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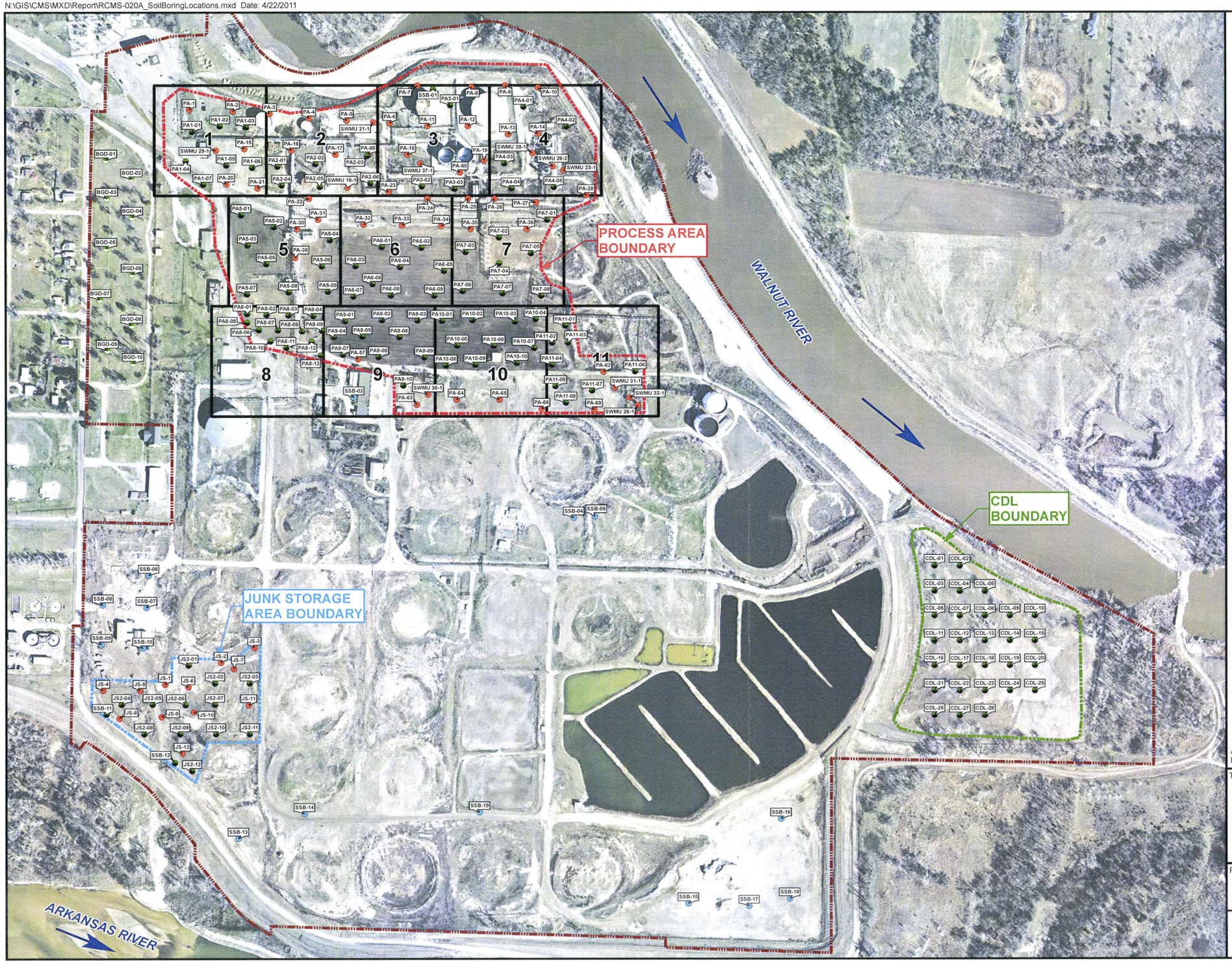


EXPLANATION

APPROXIMATE PROPERTY BOUNDARY

INVESTIGATION AREAS

- PROCESS AREA BOUNDARY
- JUNK STORAGE AREA BOUNDARY
- CDL BOUNDARY
- PROCESS AREA EXPOSURE UNIT BOUNDARY

INVESTIGATION SOIL BORING LOCATIONS

- PA-1 — SOIL BORING LOCATION FROM PHASE 2 RFI INVESTIGATION (1999)
- PA2-01 — NEW SOIL BORING LOCATION (2010)
- BGD-01 — BACKGROUND SOIL BORING LOCATION (2010)
- SSB-02 — SUPPLEMENTAL SOIL BORING LOCATION (2010)

N

W E

S

SCALE IN FEET

0 400 800

AERIAL PHOTO: MARCH 12, 2005

REVISION	DATE	DESIGN BY	DRAWN BY	REVIEWED BY
Revision 1	4/22/2011	JFM	RPH	JFM

TITLE:

EXPOSURE UNIT SOIL INVESTIGATION AREAS AND SOIL BORING LOCATIONS

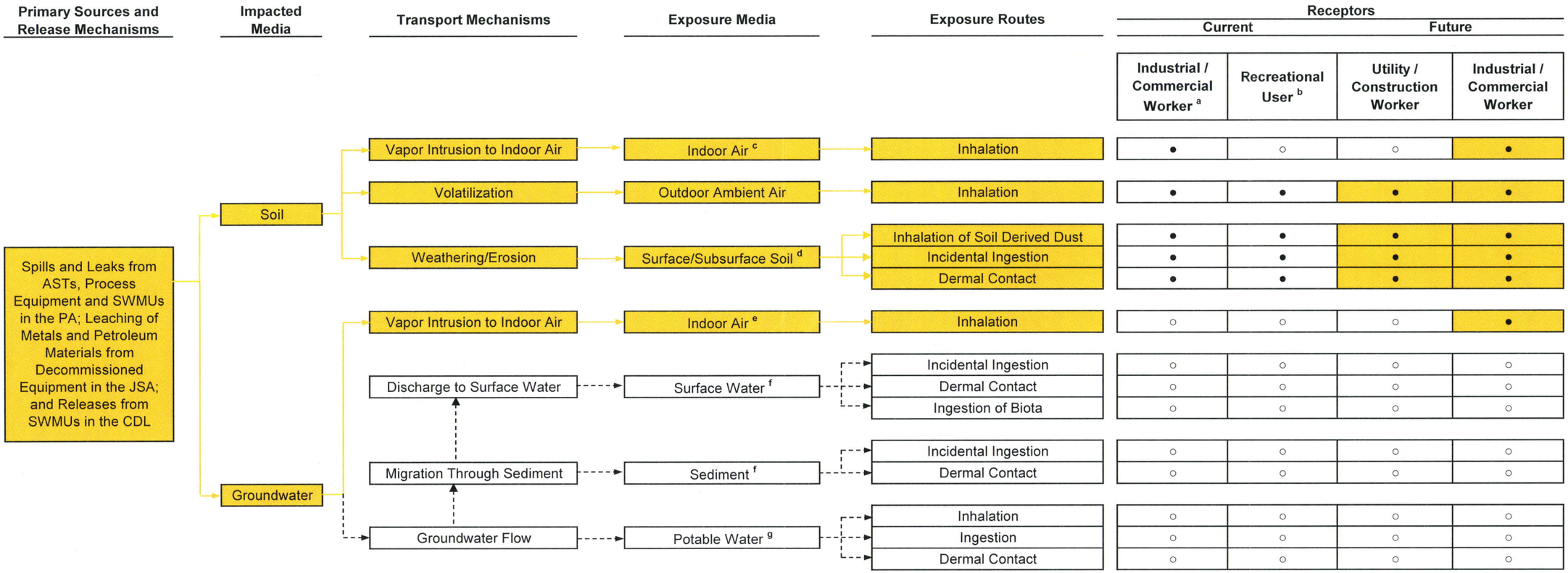
PROJECT:

MRP PROPERTIES COMPANY, LLC
ARKANSAS CITY, KANSAS

MWH

Figure No.: 2-1

Figure 4-1
Human Health Conceptual Site Model
MRP Properties Company, LLC - Arkansas City, Kansas



Notes:

ASTs - aboveground storage tanks
CDL - Construction Debris Landfill
JSA - Junk Storage Area
PA - Process Area

[a] Current industrial receptors at the Site include workers at the asphalt terminal and the facility. Although complete exposure pathways between these receptors and Site media exist, these pathways are expected to be insignificant compared with exposures associated with future receptors, and therefore will not be evaluated.

[b] Recreational users include people using the Walnut River for boating, fishing, and swimming.

[c] Vapor intrusion from soil to indoor air is a potentially complete exposure pathway for future industrial/commercial workers; however, this pathway will not be quantitatively evaluated, as described in Section 4.1.2.3.

[d] Soils will be evaluated to a depth of 10 feet (ft) below ground surface (bgs) to account for potential future construction activities at the Site.

[e] Vapor intrusion from groundwater to indoor air is a potentially complete exposure pathway for future industrial/commercial workers; however, the current groundwater treatment system is decreasing VOC concentrations in groundwater; therefore this potential, future exposure pathway will be addressed at a later time, as necessary, as described in Section 4.1.2.3.

[f] The potential migration of contaminants from groundwater to surface water and sediment is incomplete because contaminated water is captured and treated prior to discharge to the Walnut River under a NPDES permit.

[g] Potable use pathways for groundwater are incomplete because no potable wells are currently present and the installation of future potable wells will be prohibited.